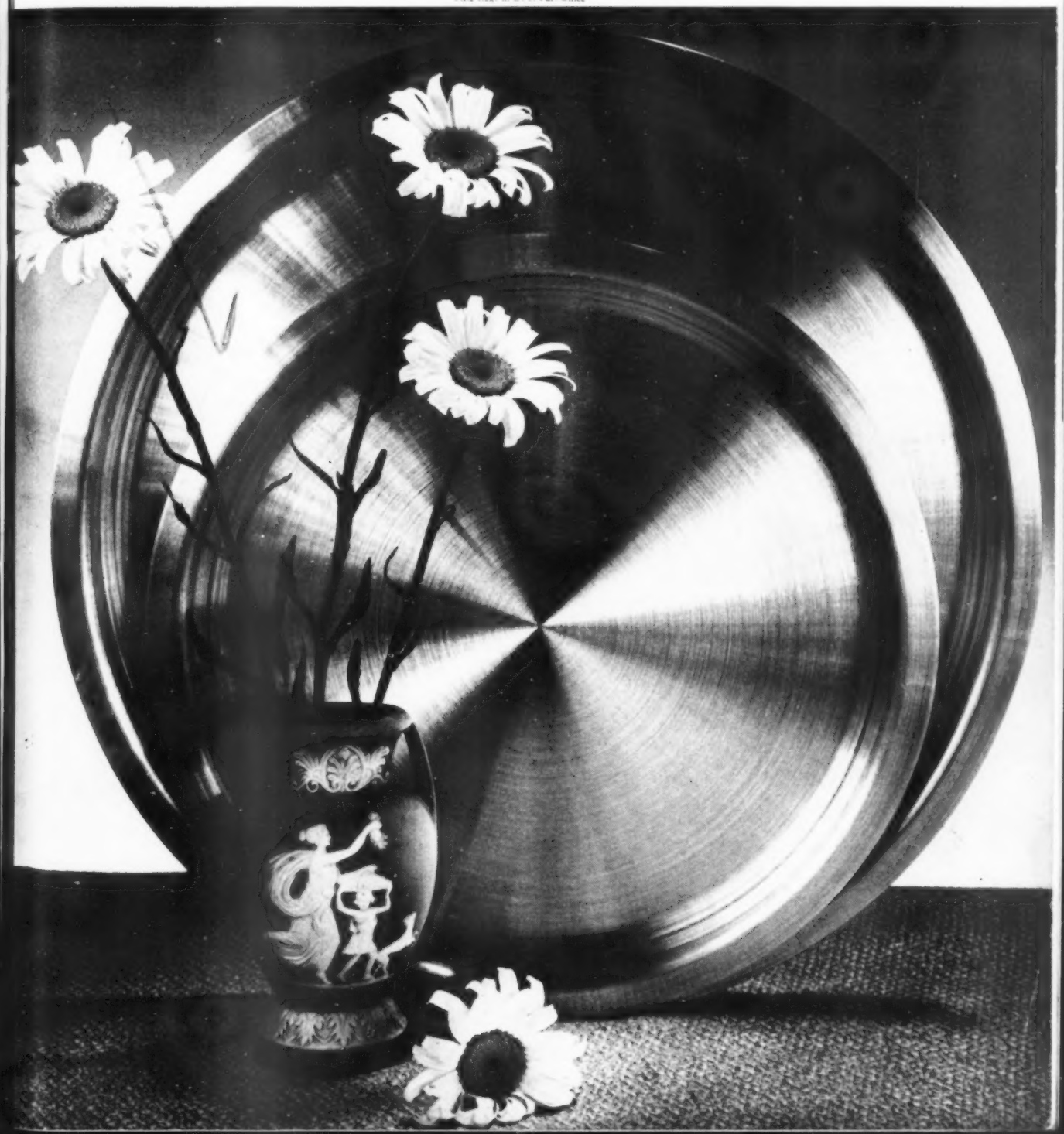
TECHNOLOGY DEPT.

April 1946

TECHNOLOGY REVIEW

Title Reg. in U. S. Pat. Office



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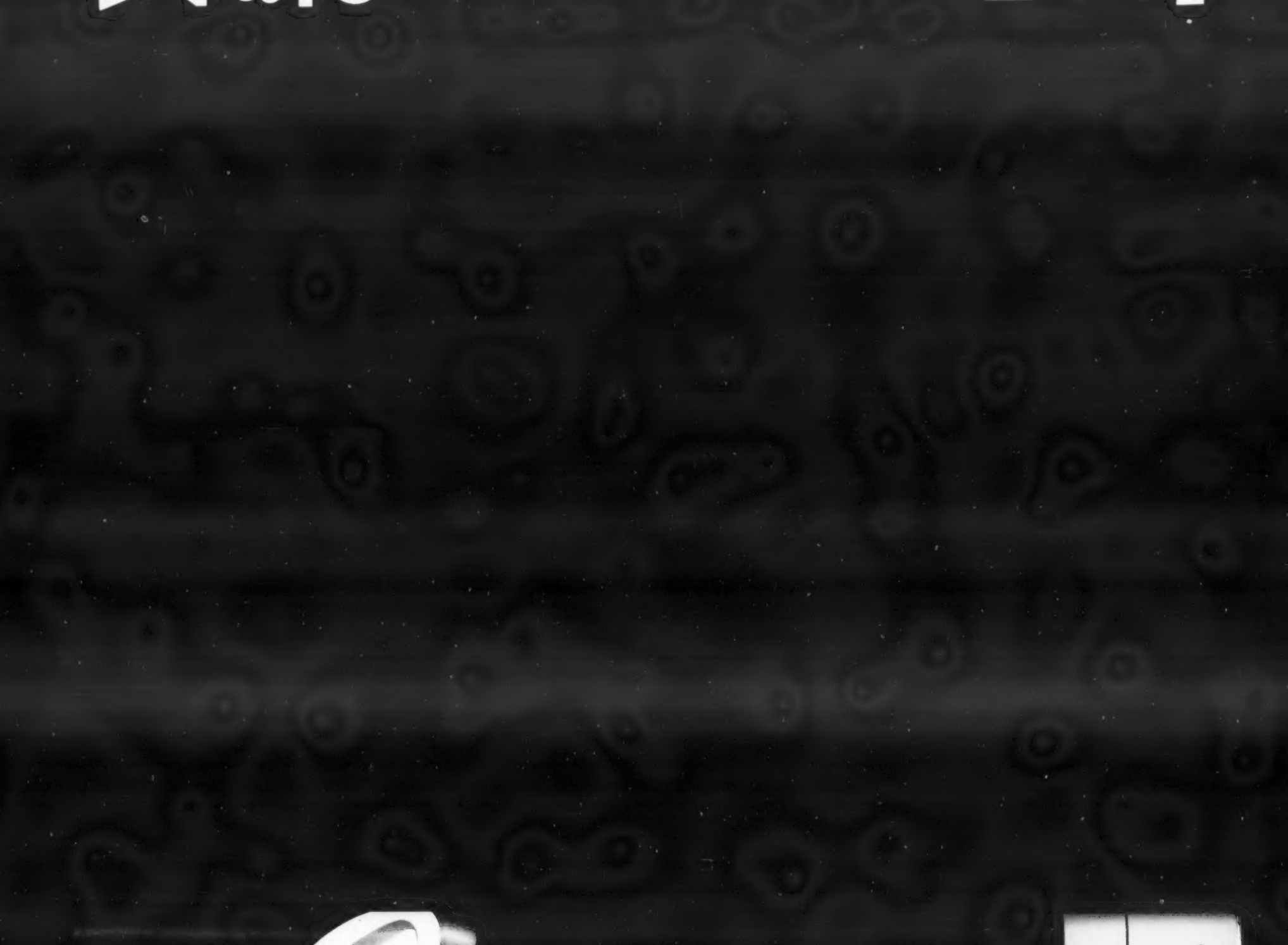

Major Eye Accidents Cost

according to estimates of the National Safety Council, an average of $328.00 per injured man per year.

Minor Eye Injuries Cost

(estimated from typical records) an average of $14.60—in first aid attention, idle machine charges and unproductive time—per injured man per year.

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sums like these: a manufacturer of electrical equipment: $14,000 in two years; a large machinery manufacturer: $44,200 annually.

An adequate eye protection program will pay for itself—often in less than six months. Why not let your nearest AO Safety Representative give you complete details?

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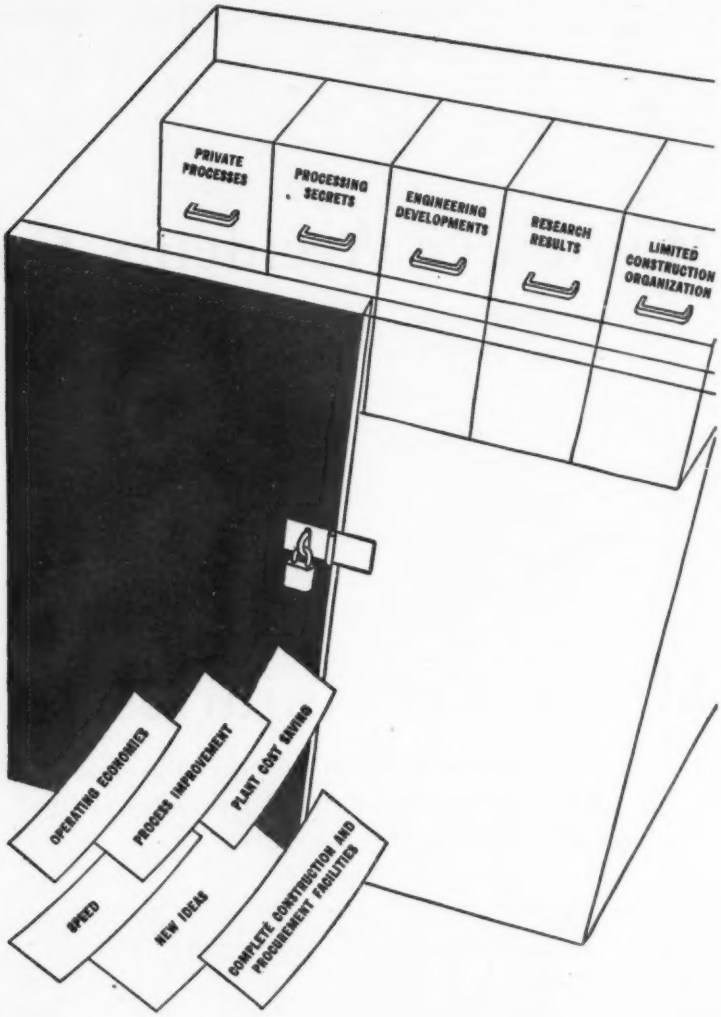
THE TECHNOLOGY REVIEW, April, 1946. Newsstand Edition. Vol. XLVIII, No. 6. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.

are you locking

OUT

more than you are locking

IN?



In a chemical world that is forever moving forward—and highly competitive!—it is natural that manufacturers should desire to keep control of the processes and plant designs their engineers have developed . . . often at great expense.

Badger offers chemical managements and their engineers the truly constructive outside viewpoint . . . with the assurance that confidence will not be violated—that private plans, processes or designs will not be disclosed or diverted into competitive reach.

Badger's broad cumulative experience and constantly developing engineering methods can provide a fresh approach to old as well as to new problems . . . and the Badger design and construction organization is experienced in efficient co-ordination with its customers.

Making new processes work efficiently in large-scale production, improving designs and decreasing operating costs, saving time and initial plant costs . . . these are some of the pay-offs Badger has achieved for many a client.

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PENFLEXWELD

is a Versatile High-Pressure, Corrugated Tubing

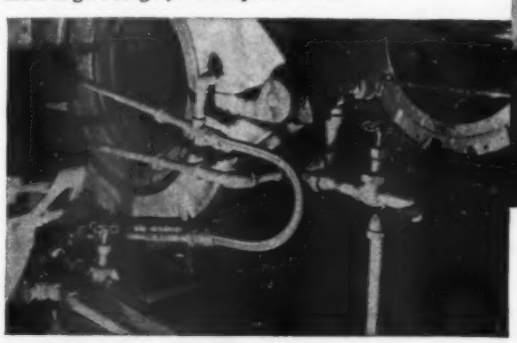
Vibratory motion on refrigeration compressors is isolated at its source by short lengths of PENFLEXWELD.

. . . designed for a wide variety of applications in industrial plants

PENFLEXWELD Tubing is invaluable in handling volatiles, liquids and gases with penetrative or solvent characteristics. Its corrugated construction expands and contracts with temperature alternations, provides extreme flexibility and resists bursting, crushing, cracking and splitting. Its jointless length is seep-proof under practically all conditions of pressure and temperature.

PENFLEXWELD Tubing available with standard braiding and protective sleeve types. End fittings, Solseal for general use where temperatures do not exceed 250° F and Metseal for higher temperatures, provide a complete assembly of leak-proof, long-lasting service on split molds, platen presses, compressors, furnace doors, open hearth furnaces and many other installations. Write for Bulletin 90 C, describing sizes 5/32" to 2" I.D. and special literature on larger sizes.

Below—*Split molds of the tire vulcanizing type are often equipped with PENFLEXWELD to enable them to give longer, trouble-free service.*



Open hearth operation requires tubing that resists extremes of temperature. PENFLEXWELD is designed to do that kind of job. Arrow points to 4" PENFLEX Interlocked Hose on high-pressure steam line.

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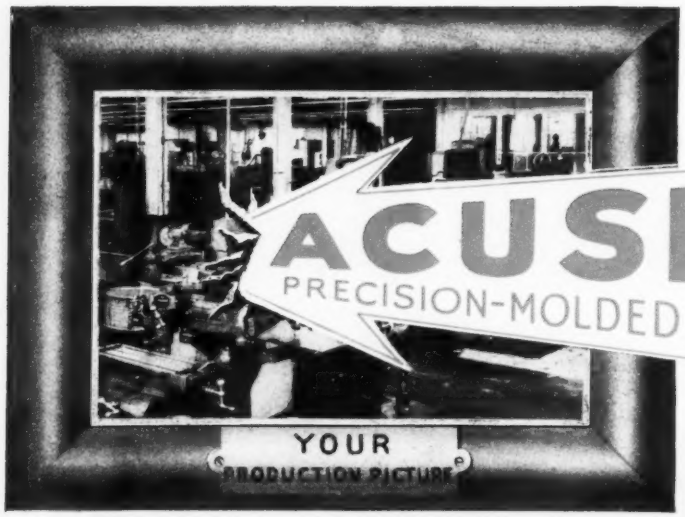

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Write to Acushnet Process Company, New Bedford, Massachusetts giving complete information, specifications or samples. No doubt our Research Records will reveal short cuts in the development of your part or product.

Though representative of our versatility, the above illustration shows only a few of the parts in constant production.

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There's plenty here you can't see

YOUR TRAIN RIDE of the future may be a more delightful experience because of something you can't see in this picture.

The thing you can't see is the customary gap between the ends of the rails. You can't see it because it isn't there. For the rails, instead of being bolted together, are welded together into lengths of solid metal sometimes a mile long.

This is done by pressure-welding . . . by forcing the rails together at their ends in the heat of oxy-acetylene flames until they become a single, continuous piece, uniform in appearance, structure, and strength.

Pressure-welded track is being used increasingly by railroads because it cuts maintenance costs and provides a smoother, quieter ride for passengers.

Pressure-welding also is used by many other industries. Some use pressure-welding for the construction of overland pipe lines . . . some for the fabrication of machinery parts . . . some for making oil-well tools . . . and some are using pressure-welding to make airplane and automobile parts.

Pressure-welding is a research development of The Linde Air Products Company and The Oxweld Railroad Service Company, Units of UCC.

If you are a bit technically minded or just want to know more about this subject, write for booklet P-4 on Oxy-Acetylene Pressure-Welding.

▼

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Bryant Thread Gages have proved their superiority for bench work . . . now, the new *Portable* gage offers fast, accurate inspection of internal threads in large castings, work in the machine, etc., or in any parts where bench inspection may be inconvenient.

The Bryant Portable Thread Gage is so accurate that it can be used to check master gages, and on production work it will check threads *all over* in a few seconds. It is 4 to 5 times faster than plug gaging. Retracting gage segments *eliminate* threading the gage into and out of threaded holes — they prevent wear — on Class 4 and 5 fits, selective assembly is possible by classing threads according to indicator readings — pilots on back of thread segments mean rapid, catchless insertion and removal of the gage — there is no chance of cross threading.

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Perfect for inspecting threads on large pieces that cannot be moved conveniently to the inspection department.

Allows checking of threads in the work in the machine.

Eliminates threading of gage into and out of threaded holes.

Four or five times faster than plug gaging.

Gives overall inspection in a few seconds—at a glance.

Master gage accuracy transferred quickly to production parts.

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THE TABULAR VIEW

Personal Responsibility, assuming increasing importance as our social organizations become more complex, is the theme of the baccalaureate address (page 347) delivered to recent graduates by HAROLD W. STOKE, President of the University of New Hampshire. With degrees from Marion College, the University of Southern California, and Johns Hopkins University, Dr. Stoke calls upon his experience as teacher, administrator, and dean of graduate schools at the universities of Nebraska and Wisconsin to remind us that no group or nation rises above the level of its individual members.

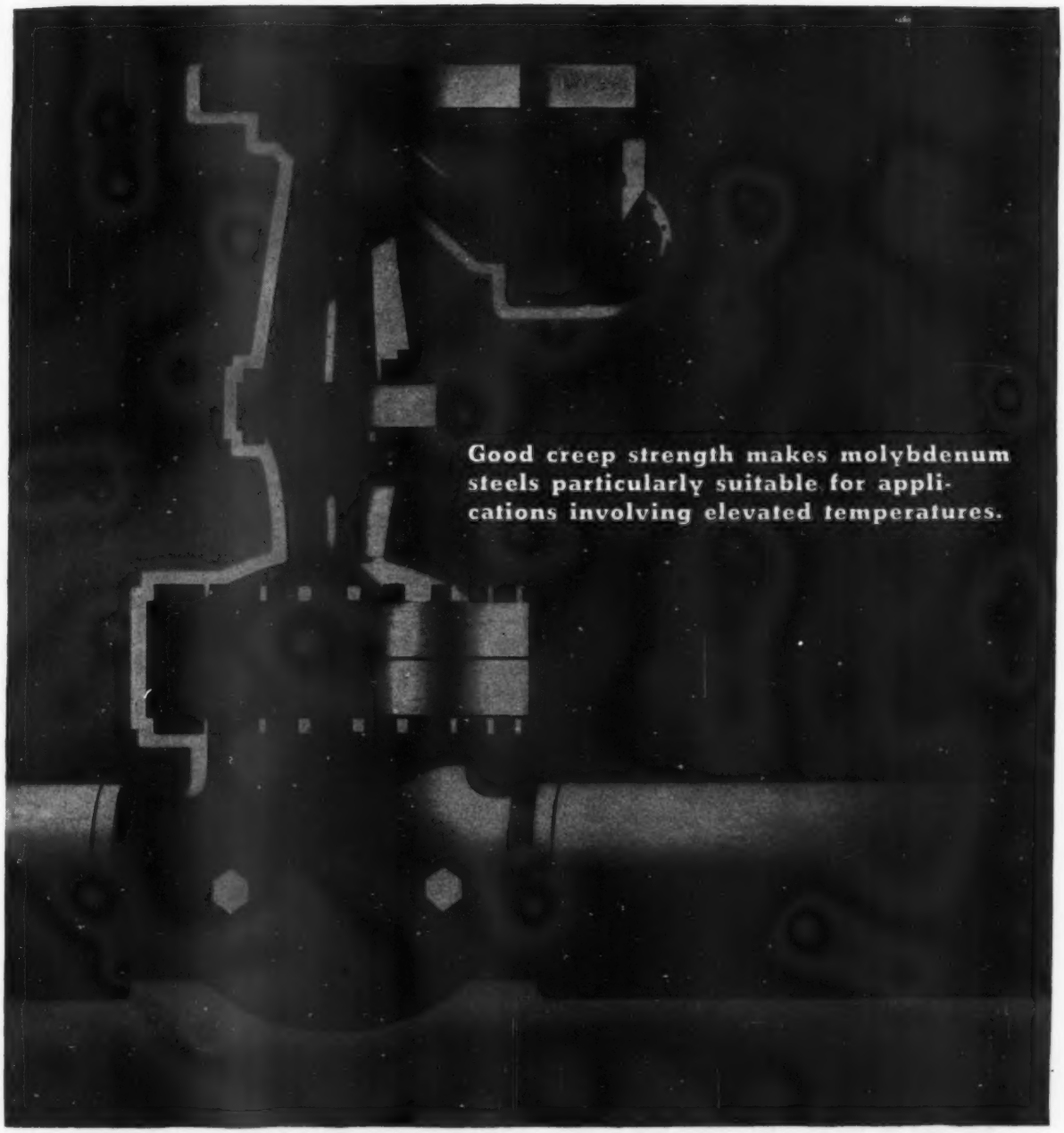
Return to Religion, stated PRESIDENT KARL T. COMPTON in his valedictory address to the graduating class (page 349), is the primary requirement in dealing with society's present-day difficulties. But the religion to which Dr. Compton refers is one of moral conduct, of application of the golden rule, and of expression of culture rather than of adherence to a specific dogma.

Today's Problem imposes the need for constant study of human relationships. Reminding us that no professional man ever completes his study, LIEUTENANT GENERAL JAMES H. DOOLITTLE, '24, goes on to point out in his commencement address (page 353) some of the needs of the aviation industry. Except for the period of study after which he received his master's and doctor's degrees from the Institute in 1924 and 1925, respectively, for research in aeronautics, General Doolittle was closely associated with Army aviation from 1917 to 1930. In 1930 he became manager of the aviation department of the Shell Petroleum Corporation, and in 1940 he was commissioned in the Army Air Corps. General Doolittle has recently returned to the Shell Petroleum Corporation as vice-president.

The Story of Radar, intimately tied up with the Institute's war activities, is related (page 355) by the director of the Radiation Laboratory, L. A. DU BRIDGE, who has recently returned to the University of Rochester to resume duties as dean of the faculty of arts and sciences. He is co-author of the book, *Photoelectric Phenomena,* author of *New Theories of the Photoelectric Effect,* and editor of the "International Series in Physics." In the fall of 1940 he was called from Rochester to direct the newly formed Radiation Laboratory. The technical achievements of the Radiation Laboratory were evaluated in "Expanded Horizons" in the November, 1945, issue of The Review. Dr. du Bridge now tells the story of the organization and operation of the Radiation Laboratory.

Ensigns in the Making were the students in the Navy's V-12 program, which is regarded (page 359) by CAPTAIN WILLIAM H. BURACKER, U.S.N., as the most interesting experiment ever to be tried in democratic education. After long and brilliant service in the Navy, Captain Buracker returned to the Institute (from which he received his master's degree in 1930) as professor of naval science and commanding officer of the Navy training

(*Concluded on page 338*)


Good creep strength makes molybdenum steels particularly suitable for applications involving elevated temperatures.

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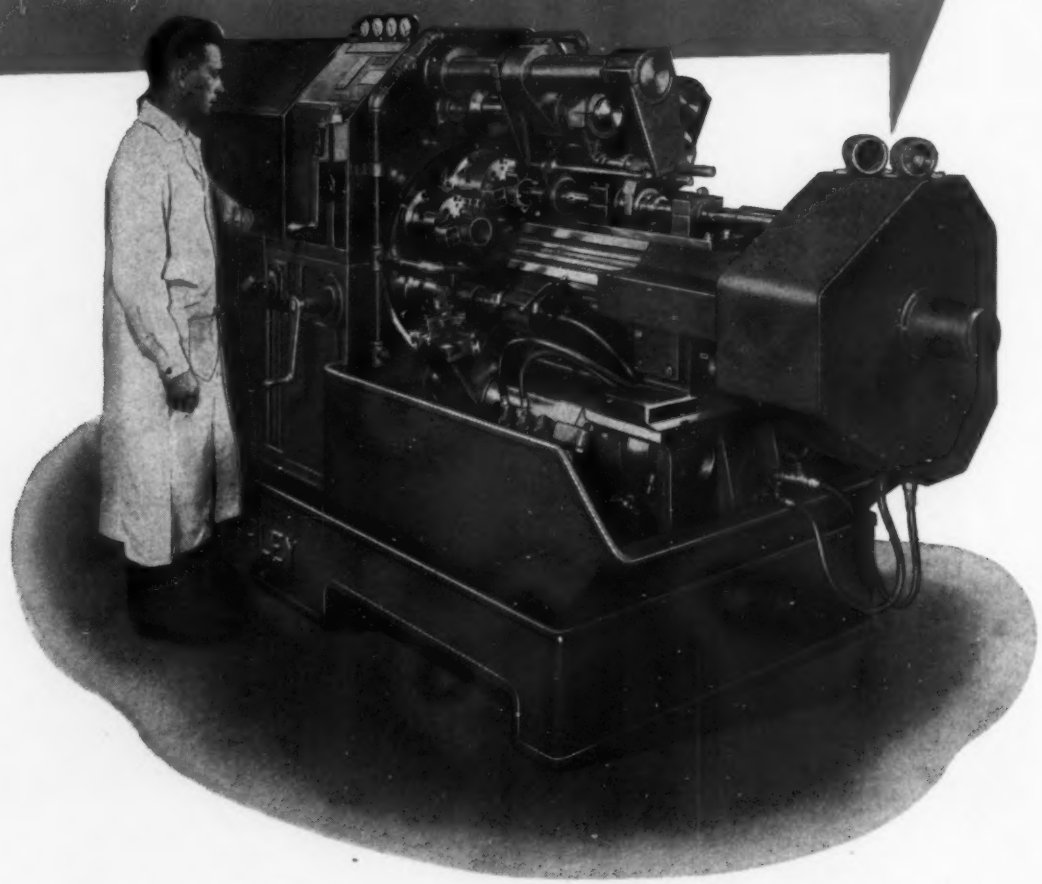
MOLY

LEADERSHIP

PROVED BY HUNDREDS OF CASE HISTORIES . . . .



Our "case history" files illustrate the fact that the speed . . . accuracy and versatility of New Britain Multiple Spindle Automatics provide the right combination for countless machining operations. Some are jobs which could not be performed in one operation on any machines except New Britains. Others illustrate high-speed, accurate machining of extremely hard metals requiring deep cuts. Others are perfectly simple pieces . . . remarkable because of the economies made possible by switching from single spindle machines to New Britains.

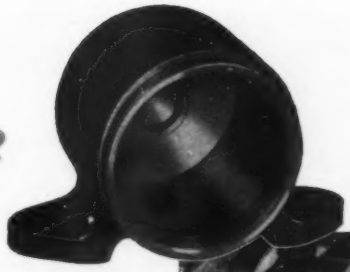
New Britain engineers stand ready to show you how the profit possibilities of New Britain Automatic Screw and Chucking Machines can be applied to your product . . . Write us about *your* machining problems.

NEW BRITAIN AUTOMATICS

THE NEW BRITAIN MACHINE COMPANY
NEW BRITAIN, CONNECTICUT
NEW BRITAIN-GRIDLEY MACHINE DIVISION

M-01033-A

. . . HERE'S ANOTHER

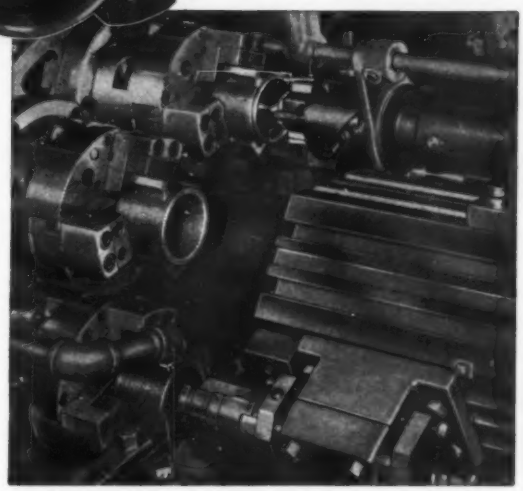


Houdaille Malleable Iron
Shock Absorber Housing

The inside surface of this shock absorber housing must be within a specified tolerance of .002" at all points. This requires not only preservation of accurate diameter, but absolute squareness of the end surface with the cylinder.

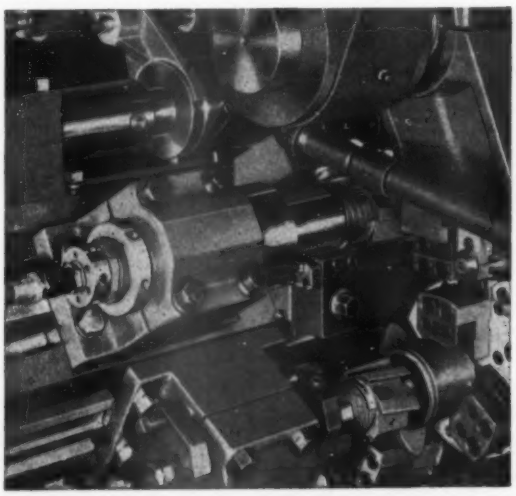
The remarkable feature of the operation is that Houdaille* turns this part out in 29 seconds, from rough casting to finished piece on a battery of New Britain Model 675 Multiple Spindle Automatic Chucking Machines . . . *with no finish grinding required.* The production of 122 pieces per machine per hour, day-in day-out is an ideal instance of how the speed and accuracy of New Britains combine to give you the utmost in production and low cost per piece.

*Pronounced—Hoo-dye



FRONT VIEW

Entirely open end construction provides accessibility for simplified chucking, cutting tool and attachment setup.



★

REAR VIEW

Wide open end construction provides extra large chip space . . . accessibility from three sides and from above that permits excellent visibility and easy tool adjustment.

New Britain builds a complete line of Multiple Spindle Automatic Chucking Machines . . . four, six and eight spindles up to 12" capacity . . . Also a complete line of Multiple Spindle Automatic Screw Machines to 2¼" capacity.

STARRETT TOOLS

Set the Standard for Quality Control

Let safe, dependable Starrett Precision Tools handle those extra production inspection operations that make the difference between a final OK and a reject. Made by master toolmakers — by men who know how to make good tools — they combine unfailing accuracy with convenient design to produce precision work with ease and efficiency.

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IRON WORKS
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Shipbuilders and
Engineers

•

BATH, MAINE

THE TABULAR VIEW

(Concluded from page 334)

schools at M.I.T. At the beginning of the war he was attached to Admiral Halsey's staff in the Pacific. In January, 1945, Captain Buracker was assigned to the staff of the Army and Navy Staff College in Washington, where he remained until his return to the Institute last fall.

Third Horseman — pestilence — faces many of the peoples of Europe and Asia. How the war affected the spread of disease is described (page 345) by FREDERIC W. NORDSIEK, '31, Editorial Associate of The Review and skilled writer and authority on food technology.

MAIL RETURNS

Ghost Ship

FROM ROBERT LACY, '98:

The article in the January issue of The Review about sunken ships is very interesting to me, particularly since in the past I have worked on the idea of recovering sunken treasure. I should like to have Mr. Ley tell me the depth of the water over the *Lutine*, the range of the tide there, and approximate depth, length, and breadth of the vessel.
Baltimore, Md.

FROM WILLY LEY:

Two long-distance moves within one year did not improve the orderliness of my library very much, and for this reason I have to quote more or less from memory, but I am fairly sure of my figures. As I recall it, the length of the *Lutine* was given as 65 meters, or about 210 feet, the beam as 12 meters, and the normal crew as 220. The *Lutine* is buried about two kilometers from the northeast corner of the Dutch island of Terschelling, with a mean depth of water of some 12 meters. This depth refers only to the water; in 1914 it was estimated that the *Lutine* was covered by some six meters of sand.

These figures are from memory, and even if they were precise in 1914, they certainly do not apply now. The resting place of the *Lutine* is in the path of a strong current, so that there are steadily shifting sandbanks and varying depths. It is quite likely that the wreck has broken up in the meantime, but it was still in one piece in 1913.
Washington, D. C.

Speed with Economy

Alex. Smith & Sons Carpet Co.

When you select a reliable builder, you can keep your mind on *your business* instead of on the building project . . . Important these days.

W. J. BARNEY CORPORATION
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INDUSTRIAL CONSTRUCTION
Alfred T. Glassett, '20, Vice President

This question was asked in all seriousness by a dyspeptic skeptic who—looking at this same picture—evidently suspected that he might be looking at a picture of the entire city of Woonsocket.

The answer is this: Taft-Peirce occupies *all of it*—500,000 square feet of what is truly a closely knit industrial city composed of several precincts. The main plant houses the world's most famous toolroom, the Contract Manufacturing Division, the Engineering Department, and the Main Offices. Other buildings house Machine Tool production, the Thread Gage Department, the Small Tool and Gage Division, and one of the country's most complete heat-treating departments.

Any manufacturer, with engineering, tooling, special machine, production or gaging problems, can engage *any part* of these facilities as an adjunct to his own.

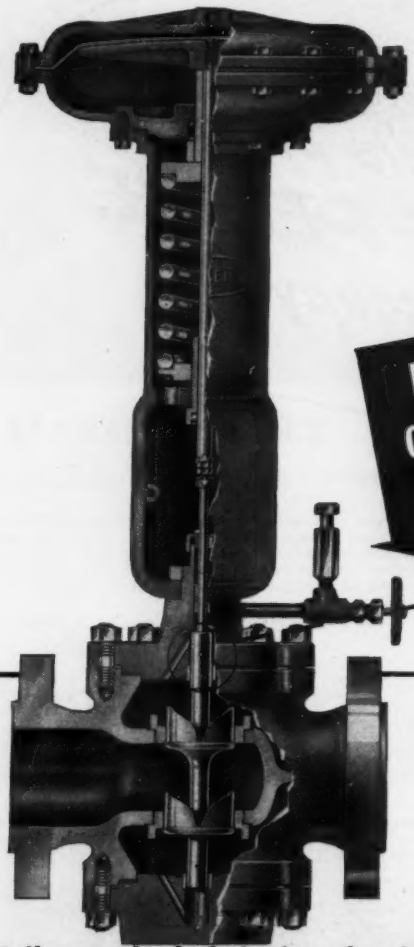
For further details, write to: THE TAFT-PEIRCE MFG. COMPANY, Woonsocket, Rhode Island.

...for engineering, tooling, contract manufacturing:

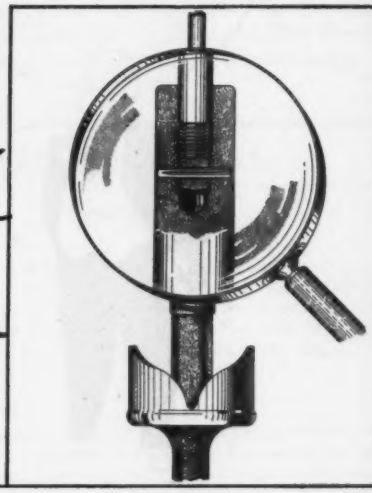
TAKE IT TO TAFT-PEIRCE

ATTENTION TO DETAIL

Pays Off in Control Valve Performance



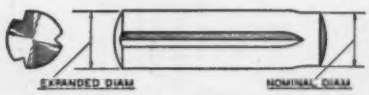
Note: One skirt of the valve plug is 90° out of position in relation to the other.



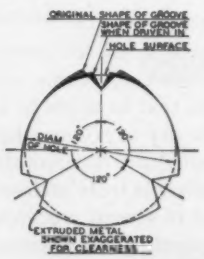
Mason-Neilan method of pinning plug & plug stem assures strongest possible assembly

The tee head construction used on some earlier control valves required clearance between the stem and plug to allow for bonnet and seat misalignment, permitting lost motion (vertical and rotary) which cannot be tolerated since the plug must respond to the slightest pressure change on the diaphragm.

The present Mason-Neilan threaded and pinned stem and plug construction does away with all toggles and free alignment joints, yet any tendency towards binding has been eliminated by pilot machining on the bonnet and blindhead and by holding all machine operations to close tolerances. The plug guide is drilled and tapped with a pilot section above the threads for accurate centering of the stem. The threaded joint provides the mechanical strength for holding the two parts together. The stem is locked into the plug by a special grooved pin which fits tightly at both ends in the guide as well as in the center through the stem.



Pins have three grooves extending from end to end, except for a short distance on one end which is the nominal diameter of the pin and serves as a pilot for driving.



In forming the grooves, a portion of the metal is displaced locally at the sides leaving a bulge of extruded metal along the edges of grooves and resulting in an expanded diameter. The action consists of forcing the elastic bulges partly back into the grooves when the pin is hammered or pressed into the drilled hole, thus forming an extremely tight fit against the hole wall.

MASONEILAN

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Mildred Hatry

DAWN SAIL

THE
TECHNOLOGY
REVIEW

Vol. 48, No. 6 April, 1946

The Trend of Affairs

The Innocent Bystander

A SURVEY of the bird population on Midway discloses that two species of birds there have probably been driven into extinction because of military operations on that island. The number of gooney birds has been reduced by 50 per cent, the Bonin Island petrels, which once had half a million representatives, now have about 25,000, and only three out of 2,000 noddy terns remain. Observers on other islands have reported how bomb concussions left the ground littered with dead birds. Although the importation of rats by military ships into previously uninfested islands may prove to be the most enduring damage resulting from the war, as far as the birds and other small forms of life are concerned, the covering of these tiny land forms with acres of runways, roads, buildings, gun emplacements, and similar bric-a-brac was also an acute inconvenience. Airplanes taking off and landing at some of the more exotic bases set up during the war have killed not only birds but also enough varieties of other fauna to have stocked an elaborate zoo.

War didn't do the chickens of Europe any good either. The poultry population of Holland, for example, was reduced in five years, mainly because of lack of fodder, from 26,000,000 to less than 4,000,000. Because the Dutch culled their flocks with considerable judgment, however, the registered breeding poultry farms lost only 70 per cent of their stock, while the loss for the entire country was 85 per cent. The Netherlands, therefore, finds itself in a position to build up its flocks to a higher level of effectiveness than ever before. Although Holland is known best for its dairy products, Dutch exports of eggs in prewar years slightly exceeded in value its exports of milk and milk derivatives.

In the oceanic realm, war actually benefited at least two creatures. Because of man-power shortages and its classification as a luxury, the lobster was less assiduously pursued, at least along the Maine coast. Whaling in the Antarctic, where the great bulk of whales are taken, virtually ceased during the war years. Compared with the 35 floating factories operating in far southern waters during the 1938-1939 season, only nine factory ships are currently at work. The fleet is no longer cosmopolitan, as six of the ships are Norwegian and the remainder are British. Oil yield, however, is expected to be about a third of a normal year's production.

The five-year holiday has undoubtedly halted the sharp reduction in the number of whales noted in certain areas, but it has not necessarily reversed the trend materially, in the opinion of biologists, because whales breed only once every two or three years and have a single offspring. More encouraging is the fact that international agreements for limiting the size of catch, which started in 1937, are being continued with an increasing number of restrictions. On the face of it, the present treaty would limit the total production of oil to less than two-thirds of the 1938-1939 catch. The absence of Japanese ships, notorious for their indiscriminate slaughter of all sizes and types of whales, and the strict regulation of their activities in home waters, are also optimistic factors.

Third Horseman

By Frederic W. Nordsiek

IN the wake of War ride Famine and Pestilence, and closely following these Three Horsemen is the fourth, Death. Wartime and postwar outbreaks of pestilence not only emphasize the thinness of the crust of civilization upon which rests modern public health but also draw attention to the possibility of world-wide epidemics, because a focus of communicable disease anywhere on the earth may act as the spark from which such a pandemic could spread like a forest fire.

War has ridden away from Europe, but Famine and Pestilence remain behind. Even those diseases controlled by sanitation of the environment, diseases that were almost eradicated from the United States decades ago,

Wind Witch — *Mildred Hair*

have flared up in war-torn areas abroad. Typhoid fever, for example, may be eliminated by sanitation of foods and water supplies and by proper disposal of sewage and other wastes. Yet these fundamentals of public health have so sadly retrogressed in sections of Europe that typhoid fever has recurred widely. Last fall the incidence of typhoid fever in Germany was at 30 times the normal rate.

Other diseases controlled by environmental measures are those spread by insect vectors; in this connection it must be acknowledged that the war stimulated the development of powerful new insecticides, such as D.D.T., and that availability of these substances immeasurably improves the prospects for ultimate elimination of insect-borne disease. Yet in the war-affected areas, sanitary measures, such as prevention of mosquito breeding, have so deteriorated that insect-borne infection has increased. Mosquito-spread malaria is epidemic in Greece and is the predominant cause of disability in the Mediterranean basin. Present plans for malaria control there call for equipping planes to spray with D.D.T. the marshland areas where mosquitoes breed; it is hoped that this procedure may drive malaria from Greece within a year.

By body and garment dusting, D.D.T. is also used against louse-borne typhus fever to kill the lice that convey this disease. Through such use of D.D.T. typhus has been practically eradicated from those areas of Europe occupied by British and American authorities, but this disease continues to occur in Bulgaria and Greece and is a serious problem in many parts of the Balkans.

Plague is another infection spread by lice, but since reservoirs of this disease may be maintained in rodent populations, plague elimination goes beyond insecticide application to involve rat control. At present, plague is serious only in Malta, but it is considered to be a potential menace because North Africa and Palestine remain foci of plague infection.

Smallpox is amenable to control by a specific and entirely effective measure, vaccination. Application of vaccination against smallpox depends upon education, legal compulsion, and availability of medical services; social forces currently are so lacking in Italy that smallpox has now become prevalent there.

Education, legislative measures, and provision of medical care, regardless of ability to pay, are likewise fundamental to the control of venereal diseases. It is not surprising, therefore, that the war has wiped out all of the progress made against venereal disease in Europe during the previous 20 years. Most of the war-affected continental countries have experienced a three- to ninefold increase in syphilis, and this infection has increased twentyfold in Germany.

Finally, there are those communicable diseases for which available control methods are less specific than they are dependent upon segregation of infectious sufferers, improvement of living standards, and prompt application of medical measures proven effective for cure or arrest. Important among these are tuberculosis, which has greatly increased in many (*Concluded on page 384*)

Personal Responsibility

In an Age of Power and Collectivism, Individual Qualities Are Recognized as of Basic Importance, for No Group or Nation Rises Above the Level of Its Individual Members

By Harold W. Stoke

Baccalaureate Address

BACCALAUREATE exercises are among the few occasions in life which give us an opportunity to pause and look in two directions — the direction from which we have come and that in which we are going. They afford us a moment to get our bearings and to enjoy the contemplation of studies completed, of professors conquered. These are occasions in which parents may beam in unashamed pride over the achievements of offspring whom they have cajoled and spanked into good citizenship. Today, in the dignity of caps and gowns, all members of a graduating class look alike — those who are here by the skin of their teeth and those whose minds are so far ahead that their willingness to remain with us was a form of tolerance.

Such moments as these, moments of pride and superiority, are all too few. I suggest we enjoy this one to the full, that we encourage these graduates and their radiant parents and friends to make the most of the successful conclusion of a great adventure. We may be serenely confident that the qualities of mind and character which have brought about these achievements will insure with equal success the accomplishments of the future.

Yet the future is insistent and compels us to turn, however reluctantly, from the review of present accomplishments to the "undone vast." We find ourselves called upon to contemplate the world in which we live.

Of the myriad facts from which we must select, in order to be intelligent about our world, there is one which seems to me to be more central than all others. It is the problem of what to do about the use and management of power. Ours is an age of power. A long series of discoveries has taught us to unlock billions of units of sheer physical energy from coal, oil, chemicals, and tumbling water. Little by little, but with accelerating speed, these discoveries have extended our control of power. Today, we stand in the presence of men who have brought that extension to emphatic climax with the release of energy from the atom itself. How completely our world is shaped by the organization, the management, and the application of power! Economically, it is the central factor in the production of goods; socially, it is the central factor in the determination of the well-being of people; politically, the use and management of power is the central problem of government, domestically and internationally.

But it would be presumptuous in this environment for me to elaborate upon the miracles of science. Mine is not an inquiry as to what further marvels science may have in store or what new dominions it may give us. Rather I wish to ask what, in an age preoccupied with the organization and management of power, is likely to happen to us as persons and as individuals?

We are told on all sides that the day of individual freedom, happiness, and responsibility is over and that the age of collectivism is upon us. The world, it seems, requires the strength of organization. To obtain it, we must definitely shift the focus from the individual to the groups to which he belongs. Certainly it requires no special insight to understand that far more organization is necessary to carry on life as we live it now than was required even a few years ago. No matter what we do these days, it seems necessary to unite with others in order to do it. If we want to work we must join a labor union, go to a government employment office, get a certificate, or register and take out a license. If we wish to go into business another series of regulations faces us. Even our minds and virtues are organized, for if we want to read a book apparently we must join a book club, and if we feel charitable we must do our giving through the community chest. And the services we enjoy, whether cashing a check, sending a package, or getting our laundry back, are dependent upon a vast association, in which each individual must do his small part in order that the great chain of social organization shall not be broken. This tendency toward the minute organization of life has been vastly exaggerated by the war. Yet in accepting it all, we are merely acknowledging the necessity for social organization superior in its claim to our own individual preferences.

What is true of ourselves in our communities is becoming true of nations. Our groping effort toward international organization is an attempt to recognize the fact that nations possess power which is too great to permit us to leave its disposition to the caprice or design of each one individually; thus it follows that, whether in the community or among nations, as our power is enlarged it imposes a need to find ways of organizing its management and use.

Many people view with alarm the lasting effects upon our minds of these developments. The over-organization of life, they say, destroys the individual. It paralyzes his capacity to make choices; it prepares his mind for dictation, creating an actual distaste for the responsibilities and virtues of freedom. It fosters a feeling of personal helplessness and fatalism toward the conditions of life which surround him. How can a member of a labor union with a hundred thousand members do other than resign himself to dull conformity, not caring whether his work is better or worse than that average for which his union's policies and wage scales are devised? How can a voter in a state with two million others keep from being overcome with a sense of his insignificance and resist the temptation to acquiesce in whatever happens? So we arrive at the great paradox that we must organize to make life richer, and thereby we endanger the richness of individual life.

There are many thoughtful people who see the protests and escapes of current living as desperate efforts to overcome this threat of individual extinction, who say that each of us must find some way of asserting his separate existence against absorption into the anonymity of a social organization. Sometimes I share these reflections and carry out a small personal rebellion, which takes the form of wearing a necktie the color of which clashes with every other item of my apparel. Unknowing persons may see in this gesture nothing but a painful lack of good taste. What they do not sense is that there for a day blazes the banner of a dangerous world outlaw, who is inwardly glowing with satisfaction at his successful defiance of the encroaching forces of social compulsion. But even such petty triumphs have never survived social pressures more than 24 hours.

It seems to me that we find ourselves in a stage of development in which we are learning those ways in which human life can be enriched, if we band together, and those ways in which it may be impoverished. We have not yet learned what aspects of human life can never be disassociated from individuals and transferred to groups and what aspects of living are better if transferred to groups and taken away from individuals. Let me try to speak more clearly.

Suppose a ship in a harbor needs to be pulled closer to shore. If you have a rope long enough for a thousand men to pull on it, you can add together the strength of the thousand men and make them collectively a thousand times more effective than each could be individually. But now suppose these thousand men are adrift in their ship on the open ocean. They have instruments which, if interpreted properly, will give them their bearings. Yet it so happens that all of these men have learned mathematics only as far as it is taught in the eighth grade. You may call all of them on deck, and by forming an organization you say, "We shall unite our knowledge, and collectively we shall know a thousand times as much mathematics as each of us does individually; thus we shall be able to read our instruments and to find out where we are." Unhappily, it does not work that way. You cannot collectivize a knowledge of mathematics. By adding together the knowledge of all of the men you have no more knowledge among them all than you had in any single one.

Keystone View Company

A long series of discoveries has taught us to unlock from coal, oil, chemicals, and tumbling water billions of units of sheer physical energy.

Now, suppose that on board you find a stowaway and discover that he has studied enough trigonometry to read the tables of navigation. The mathematics available to the thousand men through the knowledge of one man is greater than that contributed by all the others.

This kind of human mathematics deserves a great deal of reflection, for by it we see the impossibility of collectivizing the attributes which can exist only in individuals. The fact of the matter is that you can not add together the attributes and qualities of personality. These include practically all of the virtues and vices of which human beings are capable. You can not add wisdom by uniting people. Two wise people are not twice as wise as one, any more than two ignorant people are twice as ignorant as one. Two good men are not twice as good as one, or two bad ones twice as bad. This is the fallacy underlying the oft-quoted statement "A hundred million people can't be wrong." They can be, and they sometimes are, for a hundred million people may actually be less wise than a single person, since wisdom is not a matter of numbers. The basic argument for democracy is not that the masses are wiser than individuals but that we have no clear way of knowing who the wise men are.

We may pursue the matter still further. Merely by organizing or combining people we cannot increase the amount of love or hate, joy or sorrow in the world. One person is capable of knowing and feeling all there is to know of what the whole human race is capable of knowing and feeling. We have all been shocked at the dreadful atrocities of this war. The fact is that when one person has been starved or tortured to death, there has already been endured all that the human race is called upon to endure. The crime is complete in the single case. In a million cases it is but repeated a million times for there is no sum total of human suffering. Anyone who has tried to write a letter to a mother who has lost a son in this war knows what I mean. The fact that a million mothers have lost a million sons does not add one whit to the sum total of suffering. There is merely the fact that each mother has suffered what every other mother has suffered, and each of them has suffered all there is to suffer.

It is important that we grasp the true implications of this perhaps strange human mathematics. If there is any warning in the present war crimes trials, aside from how badly life can be mismanaged, it seems to me to be this: Regardless of its magnitude, the variety of its forms, and its range, social organization will always be dependent upon the qualities, virtues, and attributes which are inseparable from some individual. It is to be hoped that the implications are not lost on the plaintiffs any more than upon the defendants.

As a society we must still learn this truth, and we may suffer serious losses during the fumbling, groping days in which we are learning it. As (*Concluded on page 386*)

Return to Religion

Objectivity of Judgment and Actions, Single-mindedness, and Moral Conduct Are Urged as the Most Effective Means for Meeting the Problems of Society

By Karl T. Compton

Valedictory Address

THIS is my last message to you as students and my first message to you as graduates. I trust, however, that this forgathering is only the beginning of a lifelong frequent contact between you as Alumni and us of the Corporation and staff of this great institution. For it is one of the fine characteristics of an educational institution that its influence continues down through the years; in fact, it frequently happens that as a graduate grows older in experience he comes more and more to appreciate the value of his education and of the personal contacts established in college with his fellows and his instructors. Conversely, we of the staff, who have come to know you more or less as students and who up to the present have looked upon you as promising raw material worth working over, will realize our greatest satisfaction from watching your achievements and success. We shall come more and more to look upon you as colleagues and turn to you for counsel and help as your generation gradually takes over from us the responsibility for the advancement of science and its practical applications to achieve a better life for all.

Most of you will first undertake a tour of duty in our national service in our Navy. Some of you may decide to make this fine service your permanent career, and the others will then start civilian careers with enlarged vision and maturity. Many of you will start your life's work at once or, alternatively, undertake postgraduate study in preparation for some highly specialized professional career. Many of you will return to the foreign countries whence you came to this institution for your professional education. You will find much to do on your return. To all of you the Corporation and Faculty of the Massachusetts Institute of Technology wish success and happiness and offer our continued friendship and co-operation. From you, in return, we solicit your help as we carry on the continuing task of trying to prepare the ever replenishing ranks of young men and women to take in turn their places in the forward march of civilization.

But what will our civilization be like tomorrow? With your scientific training you can yourselves make many of the predictions. You know something of the advance of technology, and you have some basis for extrapolating this advance into the future. Even in my lifetime the progress has been enormous. My childhood vocabulary did not contain the words automobile, airplane, radio, radium, x-ray, or vitamin; yours did not include streamline, television, plastic, or atomic energy. All these are new tools which will be significant in the world of tomorrow, and the trend of science, teamed with man's ingenuity, leads without question to still newer things in your lifetime.

Let me quote from a radio broadcast which I made almost exactly five years ago:

"What will our America be like tomorrow? I look to see a race of Americans made healthier by medical progress and better living conditions. I look to see them gainfully employed in industries now undreamed of or only in the embryo stage. I look to see wealth distributed, not by taking it away from someone who has a good share but by creating it, for that is the proven way of science. I look to see people living in homes of new designs in convenience and attractiveness, based on new structural materials and located in groups planned for effective community life. I look to see great cyclotrons operating as chemical factories instead of laboratory instruments. I may see great power plants in which the fuel under the boilers need not be replenished in a thousand years. I shall certainly expect to see rain and fog eliminated from the list of hazards to travel by sea or air. These are only a few samples of what America's future looks like to me."

Now, only five years later, stop to think of the progress on all these lines: It is present-day evidence of the rate of progress toward the things that are ahead. As to a healthier race of Americans, we have penicillin and D.D.T., and we have the great new attack on cancer so largely made possible by our good friends, Alfred P. Sloan, Jr., '95, and Charles F. Kettering, and the medical profession. As to new homes, we have the greatest opportunity in all history, both on account of the pressing need and the technological advance in materials and the art of planning. Only the accumulated trash of obsolete building codes and jurisdictional entrenchments of the building trade unions stand as obstacles to a tremendous business in this area. Cyclotrons and related devices are now operating as chemical factories. In the atomic bomb development we have built boilers which can create heat without the need for replenishing the fuel for a thousand years. In radar we have a device which has largely eliminated rain and fog as hazards to air and sea travel. Though these devices remain to be developed more fully and applied widely to peacetime uses, they are no longer speculations; they are here.

Most encouraging are the enlightened public interest in these matters of technological progress for the public benefit and the leadership undertaken by the Federal Government to promote them. Although sponsored by both our late President Roosevelt and by President Truman, the program is distinctly nonpartisan and is being handled with equally devoted interest by both Democratic and Republican members of the appropriate Congressional committees. Two Senate bills, one by Senator Kilgore and the other by Senator Magnuson, provide for

the establishment of a national science foundation. The general plan has been supported by all but one of the many scores of witnesses who have testified before these committees. Senator Saltonstall from Massachusetts has played a significant role in helping to iron out differences between the two bills and to modify them to meet essentially all the criticisms and constructive suggestions regarding details. I personally believe that the most recent joint draft of these bills will win wide support and, if enacted, will prove to be a milestone on our nation's path of progress.

The other great legislation to promote technological progress is that to establish an Atomic Energy Commission. The May bill in the House and the McMahon bill in the Senate have essentially the same objective, *i.e.*, to promote as well as safeguard the development of atomic energy for security and for peaceful purposes. Some details still have to be worked out, but the legislation is certainly in the "must" category, and its enactment will clear the way for progress in this field of almost unlimited technological possibility.

Truly, you go out into a world whose future is full of opportunity in the fields of technology!

But there are other things, not so new or easily handled as scientific discovery and engineering progress, which you will encounter in the world of tomorrow. These are the problems of society as differentiated from the problems of technology. Although their form and setting may change from decade to decade, in their fundamentals these issues go far back into the fundamentals of human nature. Let me give three or four illustrations.

Take first the labor problem. I well remember a lecture which I heard as a student, at a time of widespread labor disturbances, on the subject, "Labor Unions in Ancient Rome." Wage scales, hours of work, limits on production, strikes, arbitration — all were active issues then as now.

Heinz Chapel — *J. O. Fitzgerald, Jr., M.D.*

A trait which is more important than any other and which really includes them all is religion.

Take next the problem of capital and exchange. Old King Croesus has for ages been the symbol of wealth. "Rich as Croesus" has been a descriptive phrase for centuries. In the ancient Phoenician city of Sardis, on the river Pactolus in Asia Minor, he built his palace at the junction of the great caravan routes from east to west and north to south, and he issued coins which became the basis of international exchange. His was the first world bank. Now we are creating still another.

Take again the problem of famine and relief. In ancient Egypt Joseph interpreted the Pharaoh's dream and built the granaries in which to store food in preparation for the seven years of famine which were to come. Today, in every newspaper, we read of famine in Europe as a result of war or in India because of crop failure. Not all the advances of communications, transportation, and agriculture have kept safely ahead of the resulting increases of population. Here is a problem still to be solved by both technology and sociology. Henry Wallace's ideal of an "ever normal granary" is still to be achieved, and it is as true now as in Biblical times that, "The poor always ye have with you."

Most important of all, consider the scourge of war. Man has been fighting ever since he left the jungle, and doubtless before that. There was a time when nations could stand a 30 years' war or a hundred years' war. We can no longer do that; war has become too total and too terrible. This time half the world was wrecked, and the rest was sadly weakened in only a few years. If war comes again we can be sure of one thing: The destruction and suffering will be far greater in much less time. The greatest problem of all, therefore, is how to preserve peace.

Problems like these will change in detail as technology advances, but they will continue to face us in the world of

tomorrow. Our technological progress can alleviate some of them by creating and distributing food and wealth and by generally raising the standards of living. Many aspects lie far deeper — in the fundamental character of human beings.

In my address to the graduating class of Worcester Polytechnic Institute on February 23, I ventured to urge certain traits of character which seem to me to be essential if we are ever to achieve success and happiness and peace in this world of ours. I would recommend these traits to you as I did to those graduates.

The first is objectivity in your judgments and actions. To be objective is not a natural human trait. The natural thing for any person to do when confronted with a situation is to think first of the effect on himself, then probably on his family, business, or other personal interests. Objectivity is a trait of mind which can be gained by training and experience. For example — and I say this with some hesitation — scientists or engineers should be more objective than lawyers, because they are continually called upon to evaluate situations and draw conclusions on an entirely impersonal basis, whereas in many of their activities lawyers are required by their profession to consider the interests of their clients, and politicians have to consider the interests of their constituents. I recall an interesting illustration of this difference. Early in the 1930's the Congress passed the so-called Public Utility Holding Company bill. In the preamble to this bill there were listed about 10 real or alleged abuses of the public utility holding company system. The bill then proceeded to outline a program for the elimination of public utility holding companies wherever possible and to impose restrictions on them where their elimination was not feasible. If the problem had been put up to engineers, their typical approach would have been to analyze the abuses or disadvantages of the holding company system and to draw up a parallel list of advantages. The procedure then would have been to try to seek a solution which would minimize the abuses and maximize the advantages. The approach which was followed in drafting that legislation was the subjective one, based upon the conviction that the public utility holding company system should be abolished, rather than the objective one of trying to find the best over-all solution.

I have seen the objective spirit develop, month by month, in myself and in my colleagues in connection with service on various committees, such as the one which used to award the National Research Fellowships in physics, chemistry, and mathematics. Every newly appointed member of such a board initially reacts to propositions in terms of his own acquaintance and interest. Gradually, however, a good man for such a position will develop an objective point of view in which he evaluates each proposition, not in terms of its reaction on projects or institutions in which he has an interest but rather in terms of the general progress of education, advancement of knowledge, and development of young men.

If a man's reaction to a situation is determined on the basis of his own personal gain or loss or on the basis of advantage or disadvantage to some group in which he may be interested, rather than in terms of the larger welfare of society, then he will not do his full duty to society and may even become a menace. The congressman whose votes are always with the party or whose actions are determined by political advantage rather than statesmanship is typical of one type of national hazard. The businessman whose stand on every question of social reform is decided by its effect on his next year's balance sheet, and whose reaction can always be predicted with this effect in mind, is another hazard. The extreme isolationist and the "America Firster" is still another. Of course, I would not say that considerations of personal or group interest are improper or even unnecessary. What I want to bring out is that a man's over-all judgment and action on important matters should not be determined primarily by self-interest, and usually in the most important situations it is highly important that self-interest be as completely obliterated as possible in the making of judgments.

Objectivity is a very important trait; unfortunately it is far too rare. Men who have it, combined with general qualities of intelligence and competence, are valuable and in great demand. They are the antithesis of the selfish and prejudiced. Try to be objective in your thinking.

The second trait is single-mindedness. By being single-minded I do not mean having a single-track mind. The best example of single-mindedness in our generation was the general attitude of the people of our country during the past war. Then every good and true man had just one decision to make: "Is such and such a procedure the best thing which I can do to aid in the winning of the war?" Our national strength and our success in the war were due to the predominant extent to which this spirit motivated the actions of the people and the groups of our nation. Now, in the time of peace and in the midst of reconstruction and the establishment of a future sound economy, we shall certainly succeed if we can mobilize the same nearly unanimous spirit in which our actions will be determined by the answer to the question: "What can I do which will be most effective in promoting the re-establishment of peace and prosperity?"

Without advocating communism, I think we can appreciate the effectiveness of single-mindedness in Russia. The great objective of Soviet Russia for at least the last 15 or 20 years has been technological development to make of itself a great industrial nation and thereby to provide a greatly increased standard of living for the population. In announcing the next five-year plan, Stalin states as the objective the raising of the standards of living of the laboring classes, and he states as the two procedures for achieving this objective, first, scientific research and technological development, and second, reduction in the cost of production. The strength of Soviet Russia, I believe, lies in two factors: soundness of this program and the faith and enthusiasm of the people for its achievement.

If our own nation — with a very great head start — should set high above all other economic goals more and cheaper production of the goods which people want and, until this goal is well on the way to achievement, relegate to second place the disputes about distribution of the wealth we are not now producing on adequate scale, we ourselves would be in a better position to attain what is desired by everybody, from the laborer to the capitalist, from the little businessman to the politician.

I now come to a third trait which is more important than any other and which really includes them all: religion. I am not thinking of any particular brand, or creed, or religious doctrine but rather of an attitude of mind and spirit which is the theme of a book which was a best seller about 10 years ago, "The Return to Religion" by Henry

Morning on the Farm — *Mildred Hairs*

I look to see wealth distributed, not by taking it away from someone who has a good share of it but by creating it.

C. Link, a psychologist. I mean motivation by some cause or objective which is more powerful than one's own self-interest. When a man feels that a cause or an objective is so important that it must have his allegiance and he feels this sense of duty so strongly that it takes priority in influencing his actions, then this cause or objective becomes for him a religion in the sense in which I am now using the word.

To take a relatively simple and immature illustration, let us consider a player on a football team. If he is a grandstand player, thinking of himself in relation to his play and his teammates, then he is not the man I am talking about. If, on the other hand, he has such loyalty and team spirit that for the time being his self-interest is wholly subordinated to the success of his team, then he exemplifies in this simple way what I mean here by the fundamentally religious spirit.

Of a scientist we sometimes hear it said that science is his religion. By such a statement we mean that he is so wholeheartedly devoted to his science that he will make his personal decisions and determine his course of action in the interests of science rather than in his own personal interest.

Another man will have devoted his life to the cause of the Negro, or to the better health of children, or to the cause of good government, or to the advancement of peace, as, for example, by working for the success of the United Nations Organization.

Religion does not necessarily mean that a man must choose one of these causes and pursue it to the exclusion of other interests. Very frequently there are temporary jobs, such as helping to raise money for a community fund, or taking an assignment on a committee, or helping a neighbor in an emergency. The most outstanding and vivid example in our time is that of our soldiers and sailors who were so impelled by loyalty to our nation and to their fellows that they endured hardship, risked death, and in so many cases gave their lives in the nation's cause.

There are innumerable examples of such objectives, but they all have one thing in common, namely, that the individual is impelled by a sense of duty or an enthusiasm for a cause to such an extent that, if necessary, he will sacrifice his personal comfort and interests in order to help in this cause.

The world needs men and women with this type of religion. If enough of us had it and practiced it, we could transform our nation and our world from strife to peace, from poverty to abundance, from worry and fear to hope and confidence.

So your personal success and happiness, that of our nation, and that of all nations, in the last analysis depend on character — the basic honesty, stability, and unselfishness suggested by such words as objectivity, single-mindedness, and religion. Are we willing to pull together? Are we farsighted and determined enough to make the necessary sacrifices and to plan and work hard to achieve this better world? Have we the will and the long-range good sense to resist that vicious tendency to try to get something for nothing? Have we wisdom to handle our good heritage, courage to defend it, and will to improve it?

I believe that we do have these traits to a hopeful degree. I know that we all can strengthen them by conscious effort. We may be sure that the world of tomorrow will be something somewhere between hell and paradise, depending on the degree to which mankind generally has the character to practice these virtues.

As you of this graduating class enter upon your careers with knowledge and skill and enthusiasm, may you also carry into them a single-minded devotion to truth and to the spirit which, as in religion, puts service for the good of others above selfish gain. By so doing, you will contribute your part in shaping the world of tomorrow into a better world than the world of yesterday or of today. May God be with you as you go out into this world.

Today's Problem

The Field of Human Relationships, Like That of Technology, Evolves Rapidly. Both Require Constant Study if Man Is to Achieve the Fullest Possible Life

By James H. Doolittle

Commencement Address

GRADUATION is generally thought of as the point where education stops and the application of things learned begins. This belief is only partially true. No professional man — be he doctor, lawyer, or engineer — ever finishes his education. It is essential to his usefulness and success that he remain up to date in his specialty and in allied subjects. This demand requires continued study after graduation. Such study is carried on individually and through meetings, through association and discussion with contemporaries.

Neither scientific knowledge nor its practical application is static, nor is the social environment in which we live. They are in a constant state of change and development, in some cases and directions slowly and in others, very rapidly. If you leave M.I.T. realizing the fact that you know something of today's conditions and possibilities and but little of tomorrow's, and if you are prepared to continue your own study and development in order to keep pace with the changing world, you will do well. If you are willing, through greater application and effort, to lead in some aspect of these changes, you will do still better. If, however, you think the training represented by the degree awarded you today is anything more than a good starting point, if you are under the misapprehension that you are now equipped to deal with the affairs of your generation, you are already doomed to disappointment.

I make these positive assertions with the assurance of the only scientific basis of prophecy, which is short-term extrapolation of the curve of past experience. I have been away from the petroleum industry only five and a half years, and still the changes which have taken place in this fairly stable industry during that short time are revolutionary. Since my return to the Shell Oil Company all of my available time has been spent in studying what has transpired technologically during my absence: new refining processes, catalysis, alkylation, isomerization, polymerization, new products, and new applications for old products. While flying over Oklahoma and northern Texas recently, I was amazed to see sheets of dense black smoke covering the entire countryside. This smoke came from the finely divided carbon obtained by burning waste gases in the presence of cold plates in carbon black plants. All of these plants had been erected since I left the country in 1942. The supply of carbon black is a new demand upon the petroleum industry, but its production is being very inefficiently carried out, as indicated by the carbon lost in the smoke. There is a challenge to you industrial chemists here.

The curve of scientific development is not flattening out; its steepness is increasing.

The outstanding scientific development of recent years is the harnessing of atomic energy for destructive purposes. The experimentation leading to this development has all taken place in my lifetime, as radioactivity was discovered in the same year in which I was born. By 1920 the knowledge of radioactivity acquired by the Curies, Sir Ernest Rutherford, and their pupils had established some extremely interesting scientific facts about the very heavy unstable elements of high atomic number in the periodic table, and at least one useful application had been developed, namely, radioactive therapy of cancers and tumors. In the 1920's Rutherford and his pupils discovered that various chemical elements can be artificially transmuted by bombarding them with high-velocity particles from radioactive materials or from high-voltage accelerating machines. In the 1930's this work was enormously extended with the use of the cyclotron by Professor Ernest O. Lawrence and his pupils in this country, and in 1939 uranium fission was discovered almost simultaneously by scientists in several countries. Then in 1945 we created the atomic bomb. Our scientists and engineers have demonstrated the vast storehouse of energy which resides in uranium and thorium

Problems of greatest importance in aviation are mechanical design, airports, and weather.

and which awaits only further scientific and engineering developments to bring your generation into what may be called "the atomic age."

Some of you are electrical engineers or physicists and know something of the way in which electronics underlies the modern telephone, radio, radar, and innumerable automatic devices. Yet this art, practically speaking, has come into being during my generation. I was a small child when the electron was discovered by Sir J. J. Thomson in the Cavendish Laboratory in England. Before that time there had been nearly 200 years of scientific observation of strange phenomena of conduction of electricity in the air and other gases, but both explanation and useful application were lacking. After the discovery of the electron in 1899, scientific developments and the practical application of new knowledge progressed rapidly. By the time I entered college, radio broadcasting had begun. It was during World War I that the first radio communication between airplanes and the ground was established in a very crude and unreliable manner. New scientific knowledge and more refined practical applications have developed in the intervening years with startling rapidity, and today electronics is still one of the most progressive of our technological arts.

I can best illustrate my point by drawing from the field with which I have been most intimately associated, namely, aviation. To date, this field has been a development of my generation, but aviation is still in its infancy, and your generation will carry it to much greater fruition.

On December 17, 1903, the Wright brothers made their first heavier-than-air flight. Inventors, stunt fliers, a few scientists and engineers, and the inevitable promoters carried on this infant art through the next decade. In 1912

H. Armstrong Roberts

It is not only the world of technology which is steadily evolving. The same trend exists in the field of human relationships.

M.I.T. established the first course in aeronautical engineering in the United States. It was headed by Professor Jerome C. Hunsaker, '12, who again today is head of that Department. This course was originally a postgraduate course, and the first master's degree was awarded in 1915. My own postgraduate degrees were obtained in this course in 1924 and 1925. The first bachelor's degree was awarded in 1927.

It was Dr. Hunsaker who designed the first airplane to fly across the Atlantic Ocean, the old Navy NC-4. Now the entire world is crisscrossed with a network of commercial air lines. Air has become the medium through which our most effective military arm operates. Only a month ago, a new Army jet-propelled airplane made a transcontinental flight from Long Beach, Calif., to La Guardia Field in New York, a distance of 2,470 miles, in four hours, 14 minutes, and 26 seconds, attaining an average speed of nearly 585 miles an hour.

While on the subject of aviation, let me discuss a few of the things I see ahead to challenge the courage and skill of your generation.

Of the several advantages of travel by air, speed is probably the greatest. Substantial increases in the speed of conventional aircraft through improved aerodynamic design and jet propulsion may be anticipated in the near future. Greatly increased resistance in the vicinity of the speed of propagation of sound has temporarily limited the speed of conventional aircraft, but piloted, winged, jet-propelled craft are now under construction. These planes are designed to pierce comprehensibility and operate at Mach numbers greater than one, and they will approach speeds of 1,000 miles an hour. These experimental planes may be expected to teach the lessons necessary to permit efficient military and commercial operations at these and higher speeds.

Pilotless, wingless, gyrostabilized, rocket-propelled air weapons have already achieved speeds of around 2,500 miles an hour, and we may anticipate that the air weapons of the future will also be radio controlled and radar directed. They will be capable of traveling great distance, at supersonic speeds, in the stratosphere; they will probably have an atomic war head and may even employ atomic energy as a propulsive force. This is tomorrow's military problem.

The employment of such air carriers for commercial air transport is the day after tomorrow's problem.

Today's primary problem is increasing the safety and reliability of conventional aircraft. Reliability, in general, means ability to adhere to schedule.

The three principal problems to be solved today are those of mechanical operations, airfields, and weather.

The mechanical problems associated with flight are gradually being solved, and a higher degree of mechanical perfection is being achieved. The problem of acquiring more, bigger, and better airfields poses a point of paramount importance to air development, but it is a personal or political rather than technological problem. The greatest deterrent to the safety and reliability of aviation is our present inability to predict and combat weather.

In air operations in both the European and the Pacific theaters of war, weather was the number one enemy. Enemy fighters were number two, and enemy flak was number three. During Von Rundstedt's Ardennes breakthrough, in late December, 1944, when the Eighth Air Force flew regardless of weather (*Continued on page 388*)

The Story of Radar

Engineers Extended Useful Communication Spectrum 200 Times, Devised Means for Detecting Ships and Planes at Night, and Developed the Loran System of Navigation

By L. A. du Bridge

Alumni Day Banquet Address

IT is a great pleasure to address the Technology Alumni this evening. In fact, tonight I almost feel like an M.I.T. Alumnus myself. I "entered" the Institute in 1940. "My course of study" was somewhat longer than that of the present graduating class for it was completed on January 15, 1946, and in February I resumed my duties at the University of Rochester. Thus, like you Alumni, I have had the pleasure of several years at one of the most remarkable institutions in the world. I can assure you that it is a real pleasure to return and talk to you this evening.

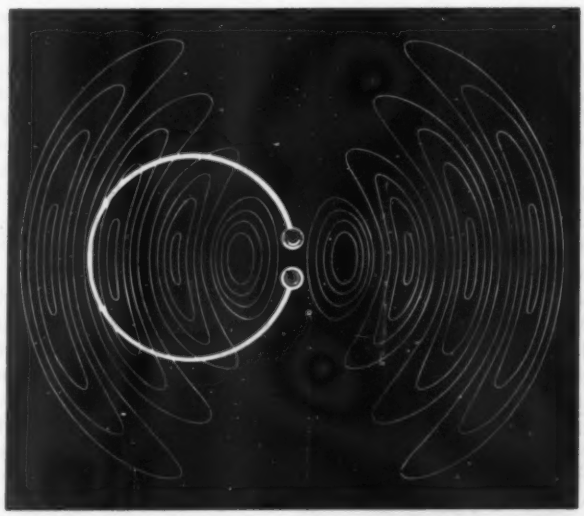
The words "Technology" and "radar" are inseparably linked, and the experiences of the past five years will live forever in the memories of many men and women.

I want to tell you a little of what went on during the war at the Radiation Laboratory, the largest aggregation of scientists ever to be assembled to work on a single problem.

The Radiation Laboratory was organized in 1940 with a couple of dozen scientists. At that time it did not appear that the problems confronting us would require a large personnel. But the staff of the laboratory grew until in August, 1945, when Japan surrendered, there were 3,900 employees, including 1,500 women. Between 150 and 200 of our staff were overseas, working with the military staffs in England, France, Italy, Germany, and in the Pacific. At the close of the war the Radiation Laboratory was spending almost $125,000 a day. Its activities required half a million square feet of floor space in Cambridge, and we had the entire Bedford airport for our use in the development and testing of airborne radar equipment. By the end of the war we had established branch laboratories in London, Paris, and Manila as well as 12 field stations throughout the United States. The Radiation Laboratory had the largest telephone switchboard in Cambridge. The number of its visitors averaged 100 a day, about half of whom were Army and Navy officers; the others were co-operating scientists from other universities or representatives of manufacturing plants who worked with us in the development of radio equipment for the armed services. The laboratory needed and had a large travel office. In addition to the many trips which the staff made throughout this country, Radiation Laboratory personnel made more than 250 round trips overseas. Yet in spite of the enormous amount of traveling required in our work, we had but one fatal casualty, which occurred in Salt Lake City in 1942.

The result of the active program carried on at the Radiation Laboratory from 1940 to 1945 was that microwave radar, unknown in 1940, had developed into a $2,000,000,000 industry by 1945. The Institute was the center of the vast co-operative program of radar development from which this new industry evolved. The Radiation Laboratory worked intimately with many technical schools and with industrial representatives throughout the United States. Because of our semi-government status, we were in contact with all agencies working on radar problems here and abroad and acted as a clearinghouse and nerve center in all microwave radar work during the war.

Why was the Institute chosen as the agency for carrying out this program? From one point of view it might seem natural that M.I.T. should have been selected as host for the Radiation Laboratory. The chairman of the National Defense Research Committee, under which the laboratory was originally established, was Vannevar Bush, a member of the Institute Class of 1916 and formerly Vice-president of M.I.T. President Compton and President Conant of Harvard were also members of N.D.R.C., and although we would hardly expect Dr. Conant to urge M.I.T. as his first choice, we might expect that he would have welcomed the chance to have the Radiation Laboratory in Cambridge! Frank B. Jewett, '08, President of the National Academy of Sciences and a member of the M.I.T. Corporation,



Symbolically expressed above is the discovery by Heinrich Hertz that electromagnetic waves a few centimeters long could be produced experimentally. The development of practical radio communication was forced to take place at much longer wavelengths because of limitations of early equipment and techniques. A return to the microwave region in which Hertz worked in 1888 has been made possible by the methods and equipment which have been developed as a result of radar research. A vast new portion of the spectrum has thereby been opened for practical use.

Radiation Laboratory

◀ *Microwave early warning radar sets, provided with plan-position indicators, are capable of portraying the positions of aircraft against a background of the surrounding terrain. The introduction of such equipment into warfare requires new concepts of military tactics.*

was also a member of N.D.R.C. Alfred L. Loomis, also a member of the Corporation, was chairman of the microwave committee, and Professor Edward L. Bowles, '22, was its secretary.

But in spite of this array of M.I.T. men (possibly because of it) the Institute was not originally considered as the location for the Radiation Laboratory. In 1940 a search was made for a place suitable for undertaking the projected research. Our research workers would be required to develop airborne radar systems and equipment. It was suggested that an Army airfield might make a suitable site for a laboratory. That idea was soon discarded when it became evident that the necessary research facilities could not be obtained at any existing field. The radar development program would have to be conducted in or near a reasonably large population center. With virtually all radio activities in the triangle enclosed by Boston, Chicago, and Washington, there were excellent reasons for choosing a site in the East. The new center for radar development would have to be in touch with, but preferably not too close to, Washington. Finally, we required an institution which could handle large research projects, one which was accustomed to the many problems peculiar to research activities and which understood what research really meant and entailed. After surveying all possible sites for the new Radiation Laboratory, Dr. Bush stated to Dr. Compton: "Karl, there is no other place for the establishment of the microwave laboratory but the Massachusetts Institute of Technology." It was in this way that your institution came to house the world's largest co-operative scientific undertaking.

But although M.I.T. was host and housekeeper for radar research, the personnel came from all over the country. The director came from the University of Rochester. As associate directors, F. W. Loomis of the University of Illinois and I. I. Rabi of Columbia University were selected to aid in the administration. Its staff was composed of scientists from almost every university in this country and from some in Canada, England, and France. The laboratory was in the truest sense a co-operative enterprise of scientists from the Allied countries.

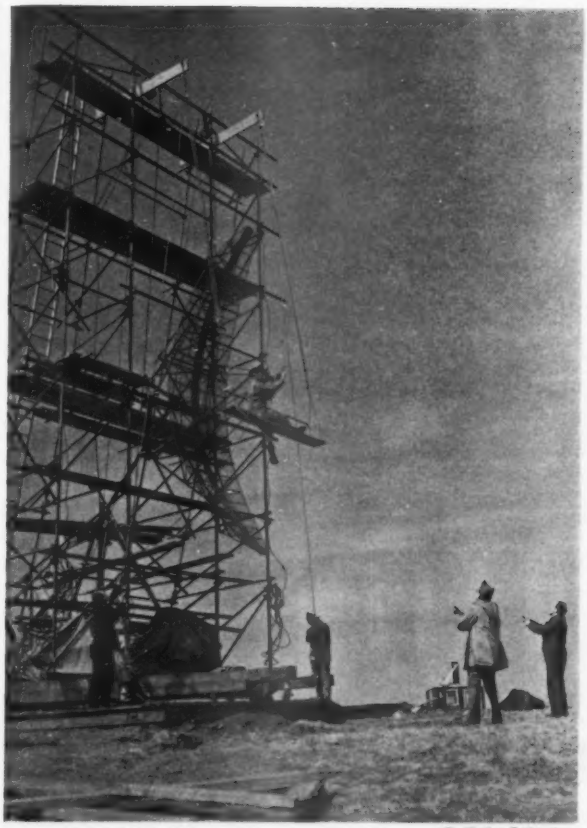
But the M.I.T. contribution was all-important. For without the farsighted management of President Compton and Vice-president Killian the Radiation Laboratory could not have been operated as it was. In none of the many other laboratories which I have visited has there been the spirit of co-operation which existed at the Radiation Laboratory — the spirit of Technology.

Now, what can I say about the work of the laboratory? You are not interested in the technical details, and even if you were, an adequate discussion of this phase of our work would take more time than could be allotted. In fact, the technical aspects of the work of the laboratory will be published in 30 volumes. All that I can do, then, is give a few examples of specific accomplishments.

Our first real job came in November, 1940, from Great Britain. A mission of British scientists visiting this country at that time urged the United States to participate with England in the development of scientific devices for military use. England was then being subjected to bombing by German planes, and the British badly needed radar detection devices. The need was especially great for radar equipment in their night fighters for detecting the approach of German planes. In asking for the aid of this country in the development of radar equipment, British scientists brought along with them the means for making such systems possible. This device was the cavity magnetron, a tube permitting the generation at high powers of radio waves 10 centimeters long, corresponding to a frequency of 3,000 megacycles a second. The tube enabled us to produce kilowatts of power at frequencies which previously could not be generated, except in minute amounts in the laboratory.

Six months after the cavity magnetron was brought to the Radiation Laboratory, we had in operation an experimental radar set for night fighters which would detect enemy bombers at a distance of several miles. The production version of this set eventually became standard equipment for American and British night fighters.

The next problem was that of protecting shipping along the Atlantic Coast against the German submarines. These submarines would recharge their batteries at night when they were surfaced and carry out their destructive attacks submerged during the day. Suitable radar would allow our planes to search and attack the surfaced U-boats at night. Several of the experimental night-fighter radars were hurriedly modified for this purpose and installed in Army bombers. The first kills soon followed, and eventually the work of the night patrol became so effective that the enemy submarines were driven from our waters. Those first sets used for this purpose, custom-built at the Radiation Laboratory, were erratic and un-



Radiation Laboratory

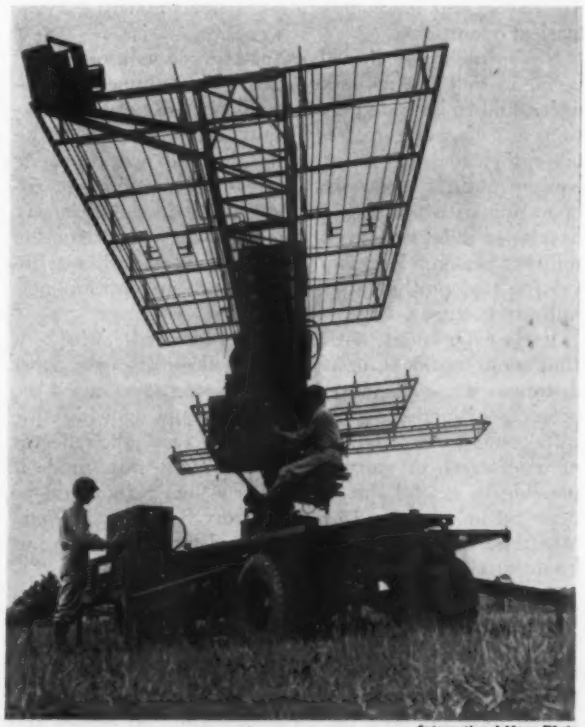
◀ *Erection of radar antenna. The equipment produced by the Radiation Laboratory had to be tested under conditions of actual operation, and this requirement often necessitated that personnel of the laboratory set up, maintain, and even operate radar equipment.*

certain in operation, and the services of a Ph.D. were required to keep the sets working. But we supplied the Ph.D., and the sets worked. Again the production models became standard equipment for Army and Navy patrol bombers.

The United States Navy was also very much interested in radar. Many ships had equipment for airplane detection, but it was not suitable for detection of other ships when operating in fog or darkness. Suitable sets for this use were developed. These were rushed into production and were first used most brilliantly in the early Pacific naval battles. The Navy also had need for night fighters equipped with radar sets, and the laboratory developed a set for this purpose.

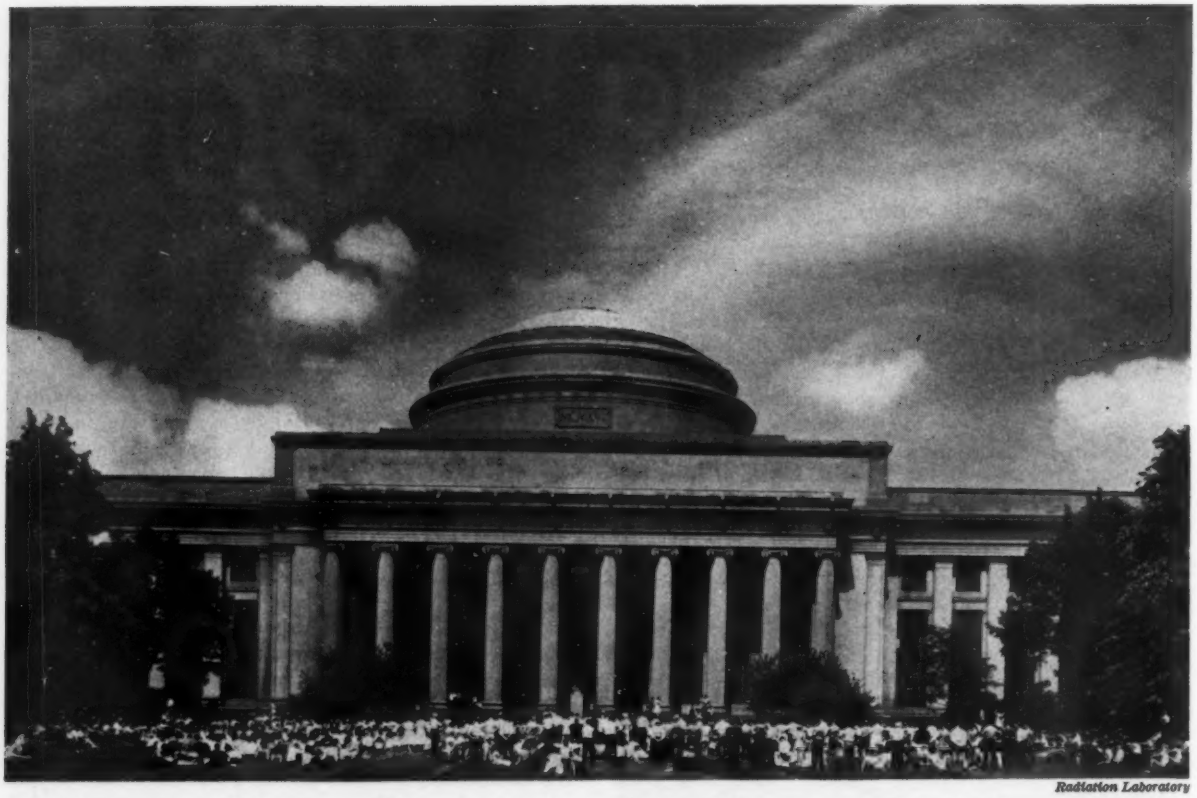
In Europe the German aircraft remained virtually untouched during the early stages of the war because radar to control antiaircraft guns was still undeveloped at that time. The need arose for radar equipment which could locate and accurately follow enemy planes at night. The radar problems were tackled in the Radiation Laboratory, and the Bell Telephone Laboratories worked on electronic computing devices. In 1944 antiaircraft guns, operated in conjunction with radar locating systems and gun computers, shot down 85 per cent of the buzz bombs which the Germans sent over England. Antiaircraft radar equipment of this type was used in Italy and in the Pacific. This same set was later modified for use in the control of our own aircraft on tactical missions, and in this role the set was widely used in the invasion of France and Germany.

The value of our early radar equipment and the success with which sets were used in combat gave us courage and hope. It even caused some of us to become fantastic in our visions for the future of radar equipment. One of the members of the Radiation Laboratory, for example, imagined a radar set with an antenna 100 feet wide, mounted on a rotating tower and designed for locating planes at distances of as much as 200 miles. While this fantastic idea — at least we thought at the time it was fantastic — was being hatched in one branch of the laboratory, more power was being obtained from our high-frequency generators in another part of the laboratory, and in still another branch great progress was being made in increasing the sensitivity of receiving sets. These two developments made it possible to reduce greatly the size of the antenna originally proposed. The fantastic radar locating system began to assume a higher degree of rationality, and by early 1944 we already had in operation radar sets which could locate and track aircraft for distances up to 200 miles. This set later became of extreme value in locating German buzz bombs and at a still later date became very popular in France when Germany was invaded. Eventually nine sets were made in the Radiation Laboratory for use in Europe and the Pacific. These sets were used with phenomenal success, particularly by the Ninth



International News Photo

Mobile trailer-mounted radar set for operation. Equipment such as this set may be regarded as the practical embodiment of ideas, many of which were originally viewed as fantastic, which originated in the Radiation Laboratory. Radar sets which could locate and track aircraft for distances up to 200 miles were in operation by the early part of 1944. ▶



Radiation Laboratory

The Institute was the center of a vast co-operative program of radar development from which a new industry was developed. From a modest beginning, in which a few dozen scientists were at work in the fall of 1940, the Radiation Laboratory grew to 3,900 employees when Japan surrendered. The photograph shows members of the Radiation Laboratory at a convocation in the Great Court, shortly after the Japanese surrendered, listening to Dr. du Bridge outline plans for the orderly conclusion of the work of the Radiation Laboratory.

Air Force, and made possible the development of new tactical operations.

Not infrequently the laboratory served as a manufacturing as well as a research organ. The equipment it produced had to be tested under conditions of actual operation, and this requirement meant that personnel of the laboratory had to set up, maintain, and operate radar equipment in the various theaters of operation, in cooperation with military authorities. In installing newly developed radar systems in combat zones and instructing military personnel in the proper use of latest technical developments, our scientists also helped to develop new military tactics.

Early experiments with airborne radar sets had shown that radar could be used to locate life rafts over short distances. The value of radar for such purposes raised the problem of increasing the effective range by which life rafts could be detected. A simple folding metallic reflector of wire screen or gauze, mounted on the raft, made it possible to extend the range over which rafts could be detected up to 10 or 15 miles. Many lives which would otherwise have been lost were saved by this simple but important development.

Another development which came from the Radiation Laboratory was a new system of navigation, known as loran. In this method of navigation, synchronized radio pulses are transmitted from a group of radio stations, the positions of which are accurately known. Specially designed receivers pick up these synchronized pulses and measure the time difference for signals arriving from each of two transmitters. The position of the ship or plane is thus determined. Networks of loran stations have now been established which make it possible for the navigator to determine his position at any time with an error of not more than about a mile. Loran systems operate satisfactorily in all kinds of weather and may be expected ultimately to replace navigation methods dependent upon the stars, which often are invisible.

Before the war the minimum wavelength which could be used in radio or radar was about five feet. Such wavelengths were much too long for providing sharp beams required for radar. A beam can be made sharp by increasing the size of the antenna or by reducing the wavelength. Radar in an airplane must have a small antenna, so short waves were essential. As it turned out they also had many other advantages. At the beginning of the war, for example, the British wanted to use in the development of their radar systems radio waves five inches long instead of those five feet long. Through the program of wartime research conducted at the Radiation Laboratory and elsewhere, methods have been devised which make possible the generation of electromagnetic waves only half an inch long, and the end is not yet in sight.

It is worth noting that the Allies outstripped the Axis partners in developing radar techniques and in producing tubes for generating very short waves. The Germans paid little attention to these problems since they believed it impossible to develop ultrashort (*Concluded on page 382*)

Ensigns in the Making

V-12 Program Viewed as Most Inspiring Experiment in Democratic Education. Graduates Attained High Average and Received Commissions and Degrees in Less Than Three Years

By W. H. Buracker

Navy Address

THIS is a unique commencement in several ways, as you are a unique class in many ways. This is the first peacetime commencement at M.I.T. since 1941; yet the graduating class is predominantly military, and the bulk of its college experience has been colored and conditioned by the war.

As senior naval officer at M.I.T. I shall devote my brief remarks primarily to the V-12 students in the class, whose college careers since July 1, 1943, have coincided with their period of enlistment because most of them entered college at the same moment that they entered active service in the Navy. Most of them have not known what a normal civilian college life is.

You are unique in that most of you have followed an academic program wholly prescribed by the Navy, whereas those V-12 students who have gone before you were permitted to follow majors of their own choice in regular courses set by the Institute.

You are unique in that this is the first time, to my knowledge, that the Institute has granted its undergraduate degree for study in curricula not established by the Institute itself. And we of the Navy are indeed proud and happy that M.I.T. so highly regarded the Navy's program that it accepted it as fulfilling requirements for graduation. Such acceptance, however, is only one of the many examples of the extremely cordial relationship between the Institute and the Navy which has been manifest throughout the whole period of V-12 training. At no time were you made to feel that you were not an integral part of the Institute. In every sense of the word you were M.I.T. men, and now you are about to become her Alumni. You were permitted to enjoy the Institute's regular sports programs and take part in extracurricular activities on the same basis as were civilian students.

It has been the policy of the officers under whom you have served to interfere as little as possible with your normal undergraduate life, to encourage hard work, and yet from time to time to remind you, as members of the armed forces on active duty, to think of those responsibilities you had to the Navy as well as to yourselves. That you accepted these responsibilities is shown in the high level of conduct and the above-average academic records many of you have achieved. You were asked to assimilate a difficult technical education in two and two-thirds years instead of four. That you have done so and maintained a better than average standard bespeaks the success of the entire program. We are proud that you, as a class, broke all records in the Navy for the officers classification test, setting a mark never before achieved by any group in the country. This success crowns an exhaustive cooperative effort on the parts of both you and your professors. We are proud that M.I.T. has supplied the Navy with 700 officers from the V-12 program alone, each of them fully trained in an engineering specialty.

The time comes now to weigh and evaluate for future reference the benefits of the V-12 college training plan. I do not speak of the material advantages accruing directly to you and your families as a result of the Navy's financing your education and maintaining you during the war years, nor of the debt you owe the American people for this incalculable privilege. You have been a part of one of the most inspiring experiments in democratic education. Let us see what has been accomplished by it.

First of all, the time saved in your training has been of great benefit to the Navy. We needed technically trained officers, and we needed them in a hurry. We got them.

You were under Navy discipline and were organized in military units. You have tasted the life of an enlisted man and should know by this time how the enlisted man feels. This knowledge cannot help but make you better officers. Also, you have absorbed in daily contacts with your officers and petty officers (*Continued on page 384*)

United States Coast Guard

You leave the Institute as commissioned officers in the Naval Reserve. You will go aboard our country's ships.

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Of Things to Come

Midst the Good Fellowship of Peace, Technology and Her Alumni Turn to Problems of the Future

TECHNOLOGY'S wartime achievements in research and technical training, the part which her graduates are destined to play in the world's reconversion from militarism to civil and industrial peace, and the Institute's increasingly important and expanding role in science and engineering loomed large in the minds of those who partook of Alumni Day, commencement, and related festivities on February 23 to 25. The first Alumni Day and commencement since the fighting war ceased was marked by relief at being once more in a world at "peace"; but it was also marked by concern for the future welfare of the world's citizens and a distinct awareness — if not apprehension — of the difficulty and magnitude of the job ahead. But highlighting the confidence with which the future was faced, the festivities were also marked by the commissioning of 195 graduates as ensigns in the Naval Reserve and by nuptial ceremonies following commencement, when at least 12 members of the graduating class took brides.

Beginning with the activities of Class Day on February 23, and extending through baccalaureate Sunday and commencement day, February 24 and 25, the good fellowship and parental pride which the occasion justified were mingled with gravity and concern, indicating that thoughtful minds are devoting much effort in attempts to attain a richer and more complete life.

As Alumni Banquet speaker, L. A. du Bridge, formerly director of the Radiation Laboratory, reviewed the important work which had transpired at that laboratory from November, 1941, until February, 1946. President Compton, in his Alumni Banquet address, outlined the conditions which confront the Institute with the ending of hostilities and acquainted his listeners with plans now in progress for a greater Technology of tomorrow. As in past years, Dr. Compton's annual survey on the state of affairs at M.I.T. was a highlight of the banquet program.

Addressing those who were making the transition from students to Alumni, Lieutenant General James H. Doolittle, '24, in his commencement address looked forward with the graduates and interpreted some of the manifold opportunities confronting them, particularly in the aviation industry. In his Navy address, Captain William H. Buracker, U.S.N., '30, expressed the conviction that the peace which had been so dearly won would be safeguarded by the Navy V-12 graduates, to whom commissions as ensigns were awarded together with their bachelor's degrees. In his valedictory to the graduates, President Compton saw hope for a brighter future in a return to a moral code of ethics in dealing with the peoples and nations of the world. It is The Review's pleasure to be able to present these addresses in this issue as separate articles or as part of this report.

Members of the graduating class in an informal chat with Vice-president James R. Killian, Jr., '26, on Class Day. From left to right: James S. Craig, Secretary-Treasurer and Beaver Orator, George A. Ley, first marshal, Herbert J. Hansell, President, John A. Gunnarson, third marshal, all of the Class of '46, and Dr. Killian.

Alumni who took active part in Class Day exercises included, in the usual order, A. Warren Norton, '21, President, Alumni Association, E. Arthur Baldwin, '96, 50-year Class speaker, Raymond A. St. Laurent, '21, 25-year Class speaker, and Charles E Locke, '96, Alumni Secretary.

Approximately 1,150 Alumni, Alumnae, and guests attended the Stein-on-the-Table Banquet at the Hotel Statler on February 23. Included in this jovial gathering were more than 300 members of the Class of 2-46, who had been inducted into membership in the Alumni Association in the afternoon in exercises at Walker Memorial. As has been the custom for several years, members of the graduating class attended the banquet as guests of Alumni Hosts, who this year numbered more than 500 Alumni and staff and Faculty members. Larcom Randall, '21, chairman of the Alumni Day Committee, and Frank R. Shaw, '24, chairman of the dinner committee, were able to relax and enjoy the banquet, every detail of which went off perfectly as the result of much hard work and cooperation on the part of the various and able committees responsible for the management of Alumni Day affairs.

. . . *Class Day* . . .

Opening the three-day festivities were the Class Day exercises, held on the afternoon of February 23 in Walker Memorial. Alumni and guests were welcomed by George A. Ley, Jr., 2-46, chairman of Senior Week. E. Arthur Baldwin, '96, representing the 50-year graduates, delivered an address to those assembled, choosing as his topic the special nature of the national debt. Raymond A. St. Laurent, '21, passed on some excellent thoughts regarding situations which were certain to be encountered by members of the graduating class in years to come. As president of the Class of 2-46, Herbert J. Hansell transferred the class ring to Alex E. Halberstadt, Vice-president of the Class of 6-46, acting for the class President, David G. Black, Jr., who is no longer at the Institute. James R. Killian, Jr., '26, Vice-president of the Institute, received from Mr. Hansell a $25 check as token of the gift of $5,000 from the Class of 2-46. In making this class gift, Mr. Hansell expressed the hope that the fund might be used to defray the expenses for portraits of prominent Faculty members, the portraits to be hung in the new library already planned.

In customary manner, the graduating class applied for admission into the Alumni Association by presenting a skit depicting actual or hypothetical events at M.I.T. during their student days at the Institute. The Class of 2-46 presentation, entitled "Curses on Zilch," was an outstanding performance and was in keeping with the generally high scholastic record which the Class had achieved during its two and two-thirds years' stay at the Institute. We shall return, in a later section of this report, to do justice to this student produced and acted four-act comedy. James S. Craig, Secretary-Treasurer and also Beaver Orator of the Class, expressed the thoughts of his classmates by stating that they felt honored at having been able to attend M.I.T., that they were happy in anticipation of their forthcoming commencement, and that they hoped that the Class had left a good impression — a hope which has been fulfilled amply during the past three years. A. Warren Norton, '21, President of the Alumni Association, presented the class banner to President Hansell, as proof of the Class's admission into the Association; the ceremonies were then concluded with an afternoon tea dance.

. . . *25- and 50-Year Graduates Heard From* . . .

As representative of the Class of 1896, celebrating its 50th anniversary this year, E. Arthur Baldwin injected a note of seriousness in his address at Class Day activities. He said, in part:

> The Class of 1896, veteran 50-year graduates of the M.I.T., is proud in the privilege of participating in these Class Day exercises. In its name I salute the young men and women who, in their diplomas, are to have testimony of their assiduous and successful years of study. I am grateful to my classmates for the high honor of appearing on the roster of the speakers who address this distinguished audience. To you all, I give my thanks for your courtesy in allowing me to speak to you.
>
> My salutation to the graduating class has particular emphasis, because our Class of 1896 was the last one to have the privilege of receiving its diplomas from the hands of the man whose memory is honored in the name of the building in which this Class Day is being celebrated.

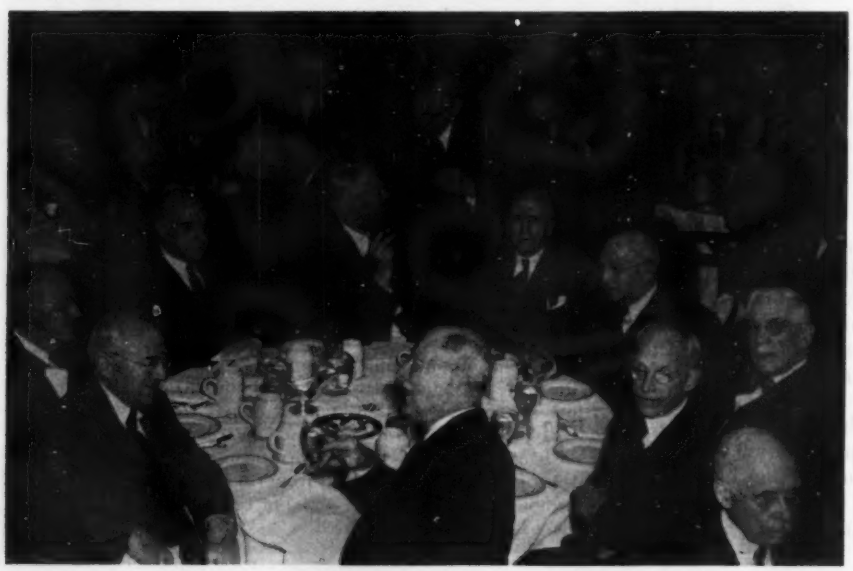
Photographed at an informal gathering at the banquet were Harold W. Stoke, President of the University of New Hampshire, who delivered the baccalaureate address, President Compton, who spoke on reconversion plans for the Institute, A. Warren Norton, '21, President of Press Wireless, Inc., and President of the Alumni Association, and L. A. du Bridge, formerly director of the Radiation Laboratory, who has recently returned to the University of Rochester.

When President Walker first addressed us as freshmen, he admonished us in these words: "The Institute of Technology is a place for men to work, not for boys to play." This was not a killjoy statement. The injunction was pointed, but you may be sure that we enjoyed ourselves thoroughly while we were students. We had all the happiness of youth. But I feel that President Walker wished us to realize that we had arrived at a kind of Rubicon; that we were passing that sort of frontier which marks the division between the selfish thoughtlessness of boyhood and the thoughtfulness that properly characterizes adult men.

That frontier is continually receding. We surmounted the preoccupations of our undergraduate work and of starting a career. But these were not all. As participants in a democratic system of government, we must look to its governance. Government action is collective in its results, but our responsibility for these results is individual and personal. We cannot safely shirk this responsibility. We cannot discharge it if we are ill-informed. We cannot be informed about public questions if we are frightened by them. . . .

Raymond A. St. Laurent, representing the 25-year Class, spoke in a somewhat lighter tone. He took time to look forward with the young graduates, whose careers are still before them, and at the same time he took leave to review a few pages which had been turned in the quarter of a century since he was a student at the Institute. In a jocular manner he pointed out some of the changes which may be expected to take place in 25 years, stating:

. . . I believe I wear the same size hat, shoes, and gloves that I wore 25 years ago, but there is the end of almost any similarity of form. Assume these extremities were held in a mold or vise, and this evening, after you have enjoyed the day's functions, you received an injection of 10, 20, 30, 40, or even 50 pounds of a solidified emulsion of fat and liquid. Tomorrow morning your resemblance to you of today might approximate me of today compared to me of 25 years ago. Also, you will see it is not entirely a matter of chest dropping and forehead being pushed back. At our 25th reunion this June, I expect to see numerous classmates who will say, "Your face is familiar, but I just can't place you." Fifty pounds and 25 years make a difference. Tonight at the banquet, look over the Class of 1921 and pick out you as you will look 25 years from now. Then you will say, "They can't do that to me!"



Turning out in grand style were members of the 50-year Class. Seated in counterclockwise order, at the near table, are F. W. Damon, R. A. Davis, P. B. Howard, F. C. Hersey, H. G. Grush, E. H. Robinson, H. E. Smith, F. T. Rundlet, and J. A. Rockwell. Talking with Mr. Hersey is H. E. Worcester, '97 (standing). At the far table, in counterclockwise order, are W. T. Dorrance, E. C. Jacobs, Butler Ames, H. R. Hedge, and J. M. Driscoll. At the lower right is B. C. Batcheller, '86, seated at one of the Class of 1886 tables.

Oh, but it is so much fun growing older. Since life begins at 40, I only started to live five years ago. My life has started many times: When I first went to kindergarten, dancing school, and Sunday school Mother says I was a cute little tyke, and your mother says the same about you; when I was graduated from grammar school and high school; when I passed my examinations to enter M.I.T., and when I completed the first term and passed; when I made *The Tech* staff as advertising heeler and finally completed the first year; and then — the climax of graduation. You will experience, as I did, the joy of beginning life with your first job, your first car (all paid for, to drive when and where you please), your first $100 earned and then your first $100 saved; then finding The Girl and getting married. There is much to look forward to in your first home and your first child, then your first promotion. I could go on and on, but I won't. Right now I'm enjoying the life which began at 40. I'm looking forward to the life which begins at 60. . . .

. . . *Class Day Play* . . .

Much to the delight of the audience — as well as of the members of the Alumni Association at which it was directed — the traditional petition for entrance into the Alumni Association was given in the form of a four-act comedy, written by Howard V. Perlmutter and Marshall J. Corbett, in which William M. Siebert as Joseph Robespierre Zilch was supported by an all-male cast of his classmates, including some prominently (if too obviously) upholstered to play feminine roles.

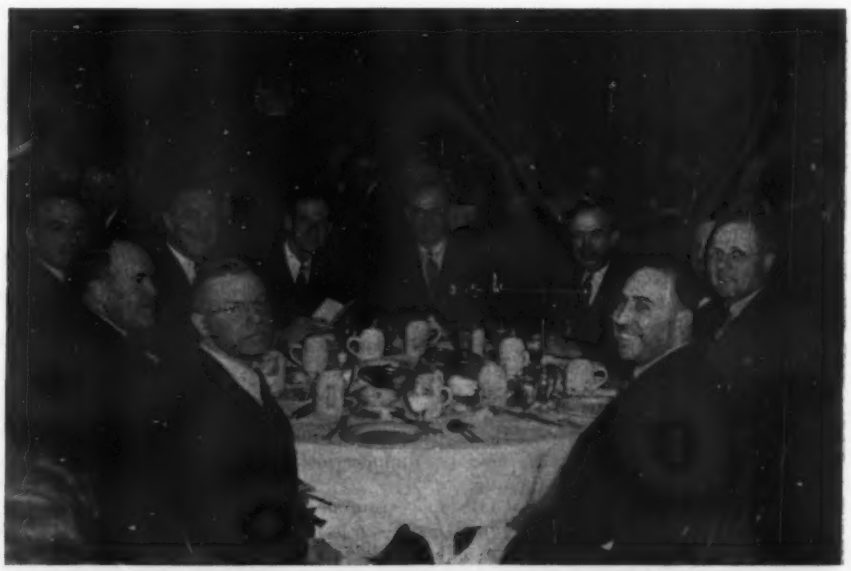
In brief, the class play dealt with the trials and tribulations of Joseph R. Zilch, a child prodigy whose future is read from a crystal ball by Observo, a soothsayer. During the soothsayer's revelation of Zilch's future, the three-year-old Zilch plays a prank on the soothsayer, thereby bringing curses upon himself. These curses bring Zilch into steady conflict with officers of the Navy, whose uniforms and general demeanor are a much greater attraction for the fair sex in the following years than are Zilch's snappy automobile and wad of bank notes. This state of affairs so disturbs Zilch that he applies for a commission in the Navy but is rejected. When his country goes to war, Zilch is reluctantly accepted as a candidate for the Navy's V-12 training, and he comes to M.I.T. for an accelerated engineering course. But Zilch's studies are not up to par, and his chances for success, as judged by his examinations, are distinctly discouraging, to say the least, particularly when these difficulties are accentuated with an almost complete muddling of his Navy activities. During drill with the company commander one day, Zilch acquires an especially large dose of trouble and, when being reprimanded, breaks the curse when he is forced to utter his middle name — Robespierre. Upon breaking the soothsayer's curse, Zilch's luck changes; he is graduated with his class, is awarded his commission as ensign, and his popularity with the girls takes on a sudden and material improvement now that he has "stripes."

In the class play, which was of unusually high caliber, a large and co-operative cast took part, including a bluejacket choir and a student orchestra. Richard J. Steele, as Lieutenant Commander Francis Curtis Cornfield, went through verse after verse of song, proclaiming in true Gilbert and Sullivan manner (as if he were part of *H.M.S. Pinafore*) that "Now I Am the Ruler of the Tech Navy."

. . . *Good Fellows Get Together* . . .

That evening, when about 1,150 Alumni gathered at the Hotel Statler in celebration of the Alumni Day Banquet, a general air of good fellowship pervaded the ballroom, as it does when good fellows get together. Led by George Wheeler, soloist, directed by Orville B. Denison, '11, and with Earl Weidner at the organ, the banqueters unloosed their voices as the ballroom (and its overflow into the adjoining halls) resounded to class cheers, *Sons of M.I.T.*, and the *Stein Song*. During the evening Commodore William A. Sullivan, U.S.N., '17, whose work in raising the *Normandie* is well known, was called upon to receive a rousing cheer as ranking naval officer among the Alumni present.

The Alumni Day steins, designed by Henry B. Kane, '24, recalling the "days that were free from care," were oft raised during the evening and were covetously sought as reminders of another Technology banquet.



Several tables were required to seat members of the 25-year Class. At one of the tables were (counterclockwise from opening) E. T. Adams, H. M. Lane, H. C. Stillman, Harry Rosenfield, W. J. Hamburger, R. W. Haskel, H. R. Kurth, class representative on the Alumni Council, C. E. Thornton, W. C. Kohl, and C. A. Clarke, Assistant Secretary.

Joining in the festivities of the Alumni Day banquet were (in counterclockwise order) Mrs. A. Warren Norton, Mrs. Frank R. Shaw, Miss Julia M. Comstock, Mrs. Harold W. Stoke, Mrs. Karl T. Compton, Mrs. Harold Bugbee, Mrs. Leicester F. Hamilton, Mrs. Raymond A. St. Laurent, and Mrs. Larcom Randall.

. . . *On M.I.T. and Radar* . . .

After the banquet, L. A. du Bridge, dean of science at the University of Rochester and formerly director of the Radiation Laboratory, spoke on the activities of the Radiation Laboratory during the war and his intimate association with M.I.T. during his directorship. Dr. du Bridge's article, "The Story of Radar," in this issue recounts the general activities of the laboratory from 1941 to 1946 and neatly supplements his article, written jointly with L. N. Ridenour, which treated some of the technical achievements of the laboratory, as recorded in the November issue of The Review.

. . . *Affairs of M.I.T.* . . .

President Compton, who had given the commencement address at Worcester Polytechnic Institute earlier in the day and consequently could not be present at Class Day activities, was, nevertheless, on hand to deliver his customary address on the state of Institute affairs. His address, always eagerly anticipated by loyal Alumni, laid open plans for new facilities and new programs for M.I.T., including those for a new library, many additional research and laboratory facilities, and dormitories. He also announced the opening of Westgate, the housing project for married veterans returning to the Institute for study. Dr. Compton's address follows:

During the last five years the M.I.T. has thrown all its energies and resources into contributing wherever possible to the winning of the war. Now we intend with equal energy and single-mindedness to concentrate our efforts on building for the future. We do this with hope and confidence because we see ahead an era of peace, in which industry and the technological professions should be able to start off by tackling the great backlog of demands and opportunities which have been dammed up by the war, and in which there is the challenge to create new technological activities on the basis of some of the exciting new scientific and engineering developments, the specialized applications of which were forced ahead during the war.

The Corporation and Faculty of M.I.T. have expressed their faith in this future by approving a large and progressive program to maintain our institution in a position of leadership and service in this new era. It is my pleasure to report to you on some of the major aspects of this program and to bespeak your wholehearted backing and help in its achievement. I think you will agree that this program opens up challenging and exciting opportunities. Let me, therefore, take up some of the more important items.

We acted promptly last fall to anticipate the temporary emergency by providing homes for married veterans returning to complete their studies. One hundred houses, small but efficient and attractive, have been erected on the tract west of Massachusetts Avenue and form a community which we call "Westgate." Although their occupancy has been unfortunately delayed by inability to secure the anticipated prompt deliveries of the kitchen units, several of the houses are complete and are now being occupied, and we expect the others to be ready very shortly. Thus, while many institutions were worrying about or planning to meet this emergency, we have actually in existence a group of emergency houses which will give very substantial relief.

Of greater ultimate importance is more adequate provision for the permanent housing of our students. Even before the war we realized the inadequacy of our dormitories. In the future the need for additional dormitories will be even greater, partly because housing accommodations in the community are far more crowded than before and partly because we are permanently increasing from 3,000 to 3,500 the number of students admitted under our stabilized enrollment plan. This increase is made possible by the additional permanent buildings erected, one in full and others in part with our own funds, during the war, and partly by the outfitting of new chemical laboratories and other readjustments within our older buildings.

. . . *Student Housing* . . .

This student housing problem has been studied by the Administration, the Executive Committee, and the Corporation's Committee on Student Activity with the result that we now have authorization to erect a dormitory to house about 300 students, to be located facing the Charles River on the tract west of Massachusetts Avenue and to be operated as a "Senior House." This dormitory will be a real students' home, complete with its own dining facilities, reading and recreational rooms, a suite of rooms for a resident "master," who will presumably be some unmarried member of the Faculty, and also a suite for visiting guests. The preliminary planning of this dormitory has been placed in the hands of the distinguished Finnish architect,

Alvar Aalto, who has returned to the staff of our School of Architecture and Planning, from which he has been absent since the period of the Russo-Finnish War. We expect this Senior House to be ready for occupancy in the fall of 1947.

. . . *Gymnasium-Auditorium Unit* . . .

With the loss of the old Hangar Gym, relic of World War I, which had to be torn down to make way for activities of World War II, a large gymnasium floor becomes a first priority requirement. As a result of the Alumni drive some years ago to provide student recreational facilities, we have as fine a swimming pool as there is in the world, a good track and track house, and an excellent battery of squash courts. We also have the small gymnasium on the top floor of the Walker Memorial building. However, a large well-equipped gymnasium with attendant locker and office facilities is essential to the physical well-being of our student body, especially during the long winter months.

The Executive Committee of the Corporation approves the erection of such a gymnasium unit, which will be designed in a manner for quick conversion, when desired, into an assembly hall (another one of our pressing needs). The necessary funds, although not yet in hand, are being sought with sufficient confidence so that the planning for design and construction is going ahead without delay. It is hoped that the final plans and the source of these funds may be disclosed at the time of the Alumni dinner in June.

In the meantime, Professors Anderson and Beckwith of our School of Architecture and Planning, who did such an outstanding job in designing our swimming pool and who have already done a great deal of work on the plans for a gymnasium, are designing this unit, which also will be located on the tract west of Massachusetts Avenue, since it has become evident that all remaining space in the tract east of Massachusetts Avenue should be reserved for academic buildings.

. . . *Automotive Developments* . . .

The automotive field is one of rapidly expanding interest and importance, as is proven by the greatly increased demand on the part of civilian students and also postgraduate students from the armed services and by the increasing number of opportunities for employment in industry. Furthermore, the striking developments of the last few years in gas turbines give convincing proof that gas turbines will be a very important type of motive power in the future.

To enable the Institute to handle more adequately its opportunities in the automotive field, our generous colleague, Alfred P. Sloan, Jr., '95, has provided funds for an enlargement and reorganization of the Sloan Automotive Laboratory to supply new facilities for instruction and research. Mr. Sloan has also provided funds to purchase from the government, as part of a gas turbine laboratory, an excellent adjacent building erected during the war for some special research on fuels. In addition to this gift, contributions totaling half a million dollars have been received from the General Electric Company, Westinghouse Electric Corporation, United Aircraft Corporation, Curtiss-Wright Corporation, and the General Machinery Corporation, all for the purpose of providing the additional building space and equipment for the Gas Turbine Laboratory and a small residue to support its initial operations. The equipment is now in process of procurement, and the final plans of the building will be settled as soon as a few remaining details of equipment are determined. These new facilities should be well under way by next fall.

. . . *Hydraulics Laboratory and Towing Tank* . . .

In his forward-looking plans for the Institute our late President, Dr. Stratton, gave top priority to an Hydraulics Laboratory and a Naval Towing Tank, but unfortunately the depression wrecked the plans which he had laid for their procurement. The need is greater now than ever, with increased technological developments in the field of hydraulics and with the steadily increasing importance of our Department of Naval Architecture and Marine Engineering, and especially its course in naval construction and engineering for postgraduate Navy students.

To meet this need, the Executive Committee has authorized the construction of an Hydraulics Laboratory and Naval Towing Tank, which will share combined facilities and will be located at the eastern end of the long narrow tract between Vassar Street and the railroad. The design of this building is already well under way and if labor and materials are available, construction should start this summer.

The funds, supplemented by an allocation from regular Institute funds, are being provided by contributions from interested companies and individuals. Two shipbuilding companies and our loyal Alumnus and Corporation member, Thomas C. Desmond, '09, have already made generous contributions, and others are pending through the activities of the group of principal shipbuilding companies and the Visiting Committees on the Departments of Civil and Sanitary Engineering and Naval Architecture and Marine Engineering.

As you know, our Machine Tool Laboratory has been located on the third floor of Building 3. Largely through efforts of the late Professor Emeritus Robert H. Smith, it was well equipped with tools which were procured as surplus property after World War I. In the ensuing interval this equipment has become obsolete, and for a number of years our Faculty and the Visiting Committee on the Department of Mechanical Engineering have felt the increasing need of a more adequate and modern machine tool laboratory.

With the help of this Visiting Committee and other interested members of the Corporation and through the devoted and able efforts of several members of our staff assigned to this project, we are succeeding in procuring from the armed forces a very fine lot of up-to-date machine tools no longer needed for war produc-

Prominent members of the Class of 1917 include William H. McAdams, Professor of Chemical Engineering at the Institute, Commodore William A. Sullivan, U.S.N., whose engineering training was directed to raising the Normandie, *and Raymond Stevens, past President of the Alumni Association.*

tion. The principal credit for this procurement goes to our late colleague, John D. Mitsch, '20, Associate Professor of Structural Engineering, who lost his life in the recent tragic airplane accident while flying from New York to Boston after attending a meeting of the American Society of Civil Engineers, in connection with which organization he was also engaged in further machine tool procurement. It is an interesting fact that associated in this project with Professor Mitsch and an active Faculty committee has been Prescott A. Smith, '35, Assistant Professor of Mechanical Engineering, son of the late Professor Robert H. Smith, who assembled our machine tools after World War I.

It has been quite clear that the third floor of Building 3 is not a good location for the Machine Tool Laboratory. The space is inadequate and can be better used for other purposes, and the floor loadings are too heavy. Consequently, the Executive Committee has authorized the erection of a Machine Tool Laboratory in the space at the western end of the tract between Vassar Street and the railroad. This laboratory will occupy the present Building 35, which is devoted to foundry, forging, and welding but which will be considerably remodeled, and will include a large addition to this building to the westward. The net result will be an excellent four-story laboratory building, adequate in size and conveniently arranged to provide for the new Machine Tool Laboratory and improved quarters for the associated Metal Processing Laboratory. This construction should also get under way this summer, conditions permitting.

We are negotiating with the government for the purchase of the substantial building, just beyond Vassar Street and the railroad on Massachusetts Avenue, which was formerly owned by H. P. Hood and Sons. Acquired by the government and remodeled during the war into an excellent research laboratory, it served to house the overflow from some of the activities of the Radiation Laboratory. We plan to use this building for some of the fundamental scientific research projects being carried on for the War and Navy Departments, to which I shall refer later.

. . . *Laboratory for Nuclear Science and Engineering* . . .

It is the unanimous judgment of all informed persons that the recent developments in nuclear science, which were rushed to application in the atomic bomb, present probably the most important opportunities in all history for new scientific discovery and for revolutionary scientific and engineering applications. The Institute should take its place among the leaders in research and education in developing these new fields and in training personnel to work in them. To this end, there has been established at the Institute a Laboratory of Nuclear Science and Engineering, headed by Professor J. R. Zacharias and participated in by members of the Departments of Physics, Chemistry, Biology, Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Metallurgy. Fortunately, we already had on our staff a few of the most competent men in the world in special aspects of this field, and we have added a large number of the outstanding young scientists who have been employed in the various great research and development projects operated during the war under the Manhattan District of the Army Engineers. So far as scientific personnel is concerned, we should be second to none in this new field. Furthermore, we have made a very substantial start in the procurement of funds necessary to carry on this work on a quite considerable scale, even in advance of any support which may later be available through the Atomic Energy Commission, which is in process of being established by Federal legislation to support these new developments in educational and other institutions.

One essential requirement for work in this field is the provision of a large laboratory, especially designed to meet the peculiar requirements of safety and convenience in the operation of the various powerful machines which are the tools of nuclear science. These are devices like the cyclotron, the high-voltage electrostatic generator, the betatron, the synchrotron, and the uranium pile.

To meet this need, the Executive Committee is studying means of financing the erection of a large new laboratory building to run north from the present Metallurgy Laboratory of Building 8, extending back toward Vassar Street on the location of the present temporary Radiation Laboratory Building 22, which we expect to tear down as soon as possible after July 1. It is certain that this project must be carried through, and I am decidedly hopeful that the means to do it can be found; to fail to do it would mean taking a back seat in the most potentially important new vehicle of technology. The architectural firm of Voorhees, Walker, Foley and Smith is already at work on the plans for this building.

. . . *The Library* . . .

I am glad to announce publicly at this time an anonymous gift of $1,200,000 for the erection of a new library. The firm of Voorhees, Walker, Foley and Smith, in association with Professors Anderson and Beckwith of our architectural staff, has very nearly completed the basic plans for the new library. Professor John E. Burchard, '23, Director of the M.I.T. Libraries, has co-operated with the architects in their planning. A most constructive move in this planning was the organization of an informal group of representatives of a large number of colleges and universities, all planning new library buildings, who were brought together jointly by Professor Burchard and Julian Boyd, librarian of Princeton University, to pool their ideas.

Our plans contemplate a really great library with many unique features, which will become the center of the cultural life and interests of our student body. It will be located in the open space between the main educational buildings and the Walker Memorial and connected with both. It will contain the library stacks, reading rooms, offices, and operating facilities and also, in or immediately adjacent to it, will be located the offices and seminar rooms and special library collections of the various departments which constitute our Division of Humanities. There is also planned a certain amount of exposition space to house our world-famous Dard Hunter Paper Museum and also temporary exhibitions of cultural and educational interest.

To build a really great library designed and equipped to exert a profound influence on our successive generations of students will probably require funds very substantially in excess of those which have thus far been provided. Consequently, the final authorization to proceed with these plans will have to await their final financing, which will be undertaken as soon as the architects' plans are complete and we have more definite knowledge of the requirements. We should have this information within a month or two.

Over and above these new additions to our physical plant, we have authorized and have under way a very substantial rearrangement and modernization of many parts of our present educational buildings. Under Vice-president Killian there has proceeded during the last two years a very comprehensive study of reallocation of space and attendant remodeling of laboratories, so that with this whole program of new facilities, our various departments and activities may be arranged and provided for in the manner most advantageous for their current operations and future development. These changes in our existing plant, together with modernization of equipment, are involving an expenditure upward of $700,000. A considerable portion of these changes are incident to reconversion from wartime to peacetime use of facilities, for which the expense has been provided for in advance through our war contracts.

When this whole program of modifications and new buildings is completed, we hope within the next two years, the Institute should be magnificently set up for its future operations insofar

(*Continued on page 368*)

REVERE COPPER IN FEDERAL 200 KW TUBE

THE 200 KW vacuum tube made by Federal Telephone and Radio Corporation is the most powerful h-f tube yet built in this country. It has been used in OWI short-wave transmitters and has demonstrated its capabilities as to power output, and dependability.

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Federal 134 Transmitting Tube, 200 KW oscillator and amplifier; length, 34-3/16".

THE INSTITUTE GAZETTE

(*Continued from page 366*)

as its physical plant is concerned, although we can still see some gaps that should be filled later. One of these which would add greatly to the morale and efficiency of our staff is a Faculty Club building, for which preliminary plans have already been developed by a Faculty Club committee headed by William C. Greene, Associate Professor of English. Few other comparable institutions lack this facility.

There are a number of other activities which are being very substantially expanded but for which we are not building new laboratories. The following are among the more important of these activities.

. . . *Electronics Laboratory* . . .

We have organized a Research Laboratory of Electronics, under the directorship of Professor Julius A. Stratton, '23, and combining the interests in this field of our Departments of Physics and Electrical Engineering. The heads of these Departments join Professor Stratton in determining the policies of this laboratory, and its facilities are available to qualified research students or staff from the two Departments, or from any other Department of the Institute having good use for them. From the Radiation Laboratory and other similar sources a number of important additions have been made to our staff and equipment in electronics, and, for the time being, reasonably good temporary laboratory facilities are available in Building 20 on the near side of Vassar Street. This is the better one of the two large temporary buildings erected during the war to house the activities of the Radiation Laboratory. A substantial program of fundamental research in electronics is currently financed by the final residual of the Office of Scientific Research and Development war contract, supplemented by additional funds from a group of industrial and governmental agencies to be announced later, under terms which provide complete freedom in the publication of results and the carrying on of research in which the basic objective is scientific knowledge, rather than the development of special gadgets or instruments. Similarly, we are providing a laboratory and excellent facilities for research and instruction in acoustics, with industrial and governmental support to be announced later.

During the past year the Corporation authorized the creation of the Department of Food Technology, under the able leadership of its new head, Professor William L. Campbell, '15. A group of four of the leading food or allied manufacturers are sharing equally in the contribution of $200,000 over a period of five years in support of the work of this Department. These companies are Standard Brands Inc., Nestle's Milk Products, Inc., American Can Company, and Dow Chemical Company. Two or three other companies appear likely to join in this project soon. Although the present laboratory facilities for this subject are sadly inadequate, a considerable improvement will be made in connection with the reallocation of space described above. We believe, however, that a new laboratory to house the Departments of Biology and Food Technology will be one of the principal requirements of the future.

Fundamental Research for the Army and Navy in various fields will continue to be an important activity at M.I.T., judging

(*Continued on page 370*)

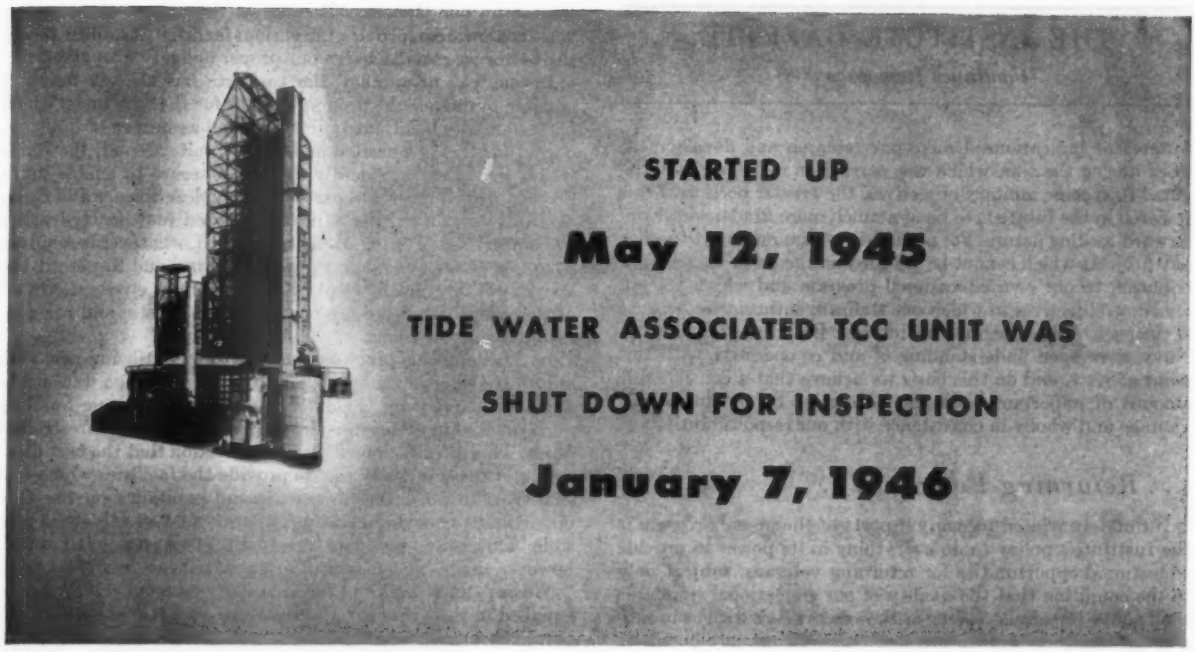
Westgate Houses Occupied. *Families have already moved into some of the hundred houses of the Institute's Westgate Development, established to meet the need for housing married veteran students at M. I. T. Originally announced in The Review on page 45 of the November, 1945, issue, with a subsequent report on page 235 of the February, 1946, issue, the Westgate Development is planned to meet the needs of young persons of limited income. The keynote of the scheme of the furnishing and decoration, designed by Mary Bassetti, the Institute's consultant on interior design for Westgate, combines simplicity, economy, flexibility, and comfort. Miss Bassetti's services are also available to veterans' families in the purchasing of furniture and various household equipment at the lowest possible cost and in planning the interiors of the individual Westgate houses.*

The houses are completely insulated for comfort in summer and winter. Double windows are provided for use during the winter. In the summer the outer windows may be replaced by screens. Heating is done by a centrally located gas-burning heating unit in each house.

Upon occupying a house, each family is provided with a complete kit of information relating to living conditions. This kit includes a floor plan of the building, a list of all equipment supplied, rules governing the use of the house, a list of the basic furniture required for simple living, and a list of additional equipment and furnishings which may be desirable but which are not absolutely necessary.

The reproductions above illustrate the living room and kitchen of one of the houses, furnished as a model for students planning equipment for their own Westgate homes. A student's study desk with ample bookcase shelving forms part of the furnishings of the living room.

The compact one-piece kitchen unit (right) installed in Westgate houses provides maximum convenience and flexibility in a minimum amount of space. The kitchen unit, only four feet wide and two feet deep, contains a four-burner gas stove with oven, an electric refrigerator, a sink, and drawers and closet space for storage. The kitchen also has its own ventilating system to carry off cooking odors.



When the 10,000 barrel per day Thermofor Catalytic Cracking unit of the Tide Water Associated Oil Company, Bayonne, was shut down for inspection on January 7, it had been on stream 240 days.

Sprockets on elevator drive were reversed to balance wear. Elevator chains were shortened by removing two links. No major maintenance was necessary. Kiln linings and internals were in perfect condition. The total turnaround labor amounted to approximately 10,000 man hours.

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If you have the problem of converting existing facilities to meet competition . . . if you are planning the installation of modern plants for the economical production of high octane motor gasoline, Lummus will be glad to co-operate with you in an unbiased study of the processes best suited to meet your refining and marketing conditions. Every Lummus study includes a thorough analysis and presentation of the economics of the proposed installation.

For further information on Lummus refinery surveys and construction, write for a copy of "Petroleum Refining Processes"; containing latest data, flow diagrams, photographs.

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THE INSTITUTE GAZETTE

(*Continued from page 368*)

by present indications. Unlike our research and development work during the war, which was carried on in secrecy and devoted to specific military objectives, the greater portion of this research in the future is to be of a much more fundamental and forward-looking nature. For peacetime we are refusing to accept any projects which cannot be justified on the basis of their contribution to our own educational program and which are not aimed at objectives in which our staff are enthusiastic because of their scientific or engineering interest. Both the Army and the Navy have been understanding of and co-operative with this point of view, and on this basis we believe that a considerable amount of important work can be carried on to mutual advantage and wholly in consistence with our responsibilities.

. . . *Returning Veterans* . . .

Intimately related to many aspects of the above program is the Institute's policy to do everything in its power to provide educational opportunities for returning veterans, subject only to the condition that the quality of our educational standards shall not be impaired. As long as the veterans are with us in substantial numbers, we will increase our limit on enrollment by 50 per cent to a total of 4,500. This number is the absolute capacity of our facilities and will require a continuation of abnormally heavy teaching schedules on the part of our staff. The pressure for veteran admission is terrific, involving 4,000 letters received a week by our Admissions Office and a local staff of 55 to handle personal interviews, in addition to the heavy load carried by our Honorary Secretaries throughout the country. The sooner we can provide the various facilities described above, the better we can discharge our proper obligation to veterans.

In one way or another, the Institute has already found it possible to finance the program except for the four items which I have already mentioned: first, the final assurance of funds required for the gymnasium-auditorium unit; second, the funds which we rather confidently expect to secure to enable us to proceed with the new Laboratory for Nuclear Science and Engineering; third, a balance still to be raised for the Hydraulics Laboratory and Towing Tank; and fourth, whatever is required in excess of the anonymous gift already in hand to permit the erection of the type of great library which we envisage. On all of these four points we are reasonably optimistic and are proceeding with the plans.

In financing this program the Institute is utilizing new gifts and the balance of the funds which many years ago were made available, largely by George Eastman, for academic building purposes and in addition is drawing heavily on its unrestricted funds. This is being done with the conviction that the best utilization of these funds is now to provide the facilities which will enable us to meet the new needs and capitalize on the new opportunities now before us as promptly and effectively as possible. This heavy draft on the Institute's unrestricted funds, however, makes replenishment of these funds a very urgent need.

We have a teaching and research staff of strength never before equalled in the history of the Institute, and these facilities will permit them, and the thousands of students who will pass through our institution in the years ahead, to have the advantage of the best opportunities within the power of this institution to provide. The program is clearly in line with the directive of the M.I.T. Charter: to maintain a school of industrial science and to advance science and its practical applications.

(*Continued on page 372*)

Folks Were Still Using OIL LAMPS When This WHS Unit was Created

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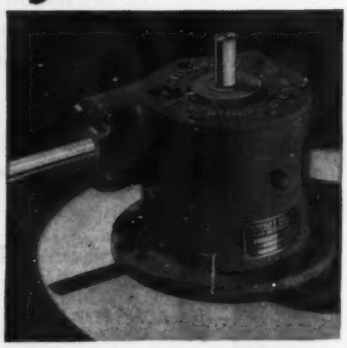

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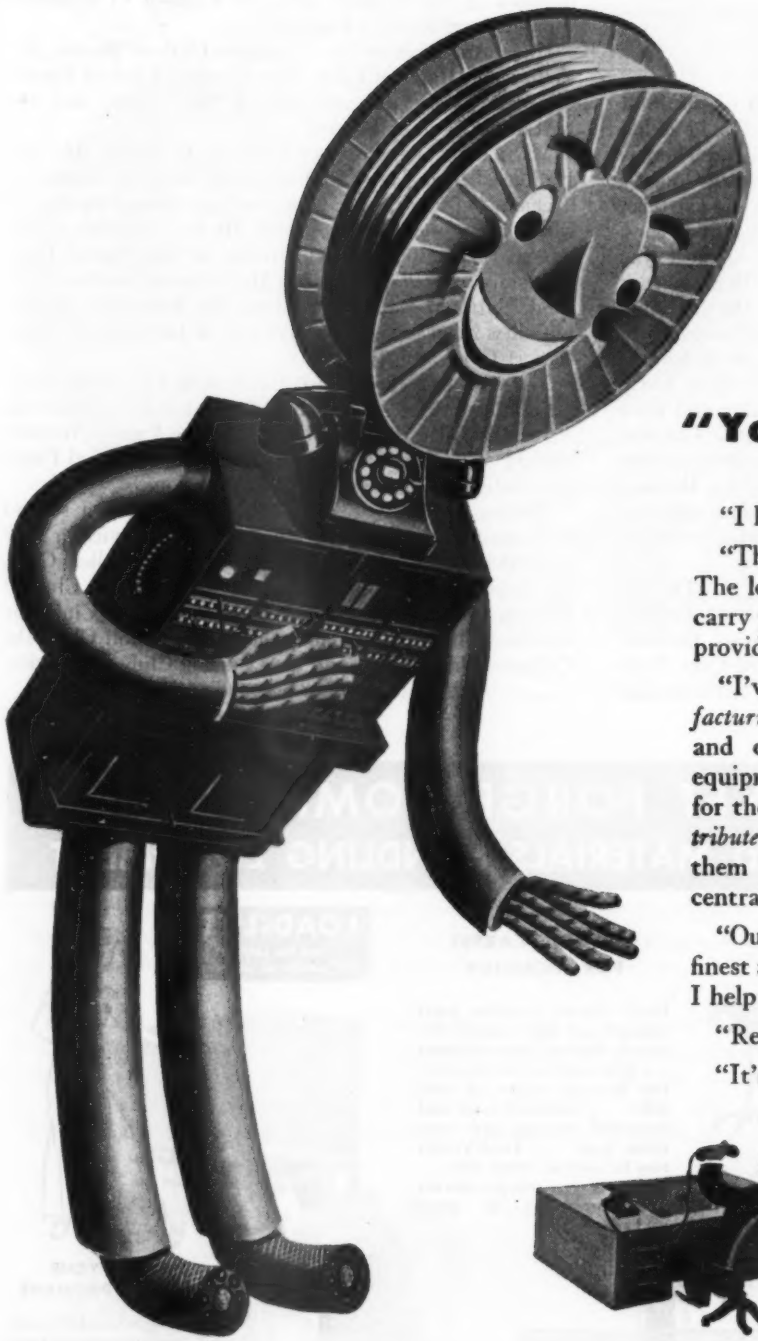

"You rang for me?"

"I have been working for you for years.

"That telephone in your hand, I made. The long thin wires, the stout cables that carry your voice at the speed of light . . . I provided them, too.

"I've been busy . . . since 1882 . . . *manufacturing* telephones, switchboards, cable and other Bell System apparatus and equipment. I *purchase* supplies of all kinds for the Bell Telephone companies . . . *distribute* all this material and equipment to them throughout the nation. I *install* central office switchboards.

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"Remember my name . . .

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DISTRIBUTOR... of telephone apparatus and supplies.

INSTALLER... of telephone central office equipment.

FOR THE BELL SYSTEM

Western Electric

THE INSTITUTE GAZETTE

(*Continued from page 370*)

Elected

CHARLES E. SPENCER, JR., President of the First National Bank of Boston, has been elected a life member of the Corporation of the Institute, and Thomas D. Cabot, Vice-president and general manager of Godfrey L. Cabot, Inc., Boston, has been elected a special term member of the Institute's governing body for five years.

A native of New Brunswick, N. J., Mr. Spencer was educated at Rutgers Preparatory School. Beginning in 1900 he was successively associated with the National Bank of New Jersey, the National Bank of Commerce in New York, the National Bank of Commerce of Kansas City, and the Trust Company of America in New York. In 1907 he was appointed assistant treasurer and later was advanced to the post of treasurer of the Colonial Trust Company of Waterbury, Conn. From 1918 to 1920 he was deputy governor of the Federal Reserve Bank of Boston, leaving that position to become vice-president of the First National Bank, of which he was elected president in 1938.

Mr. Spencer is president and director of the First of Boston International Corporation, director of Eastern Malleable Iron Company, French American Banking Corporation, Arthur D. Little, Inc., United-Carr Fastener Corporation, and the New England Telephone and Telegraph Company; trustee of the American Optical Company, trustee and director of the Massachusetts Society for the Prevention of Cruelty to Animals; and member of the Federal Advisory Council to represent First Federal Reserve District.

He is a member of the Algonquin Club of Boston, the Tennis and Racquet Club, The Country Club of Brookline, the Union League Club of New York, and the Kittansett Club of Marion.

Mr. Cabot is the son of Godfrey L. Cabot. He was graduated from Harvard University with the degree of bachelor of arts in 1919 and a year later joined the firm of which he is now vice-president. He is a member of the Executive Committee and director of the United Fruit Company and its subsidiaries. He is also a director of the First National Bank of Boston, the American Mutual Liability Insurance Company, and of the Carbon Black Export Company, Inc.

Mr. Cabot is a trustee of the Boston Five Cents Savings Bank and vice-president of the Natural Gas Products Association. He is also a director of the Family Welfare Society of Boston, Boys' Camp, Inc., the National Parks Association, and many other organizations.

During World War I Mr. Cabot served as a second lieutenant in the United States Army Air Service in 1917 and 1918. He is a member of the Harvard Travellers Club, the Appalachian Mountain Club, the Harvard Club of Boston, the Union Club, the American Alpine Club, the Harvard Club of New York, the Western Golf Club, the Cohasset Yacht Club, and the Cruising Club of America.

(*Continued on page 374*)

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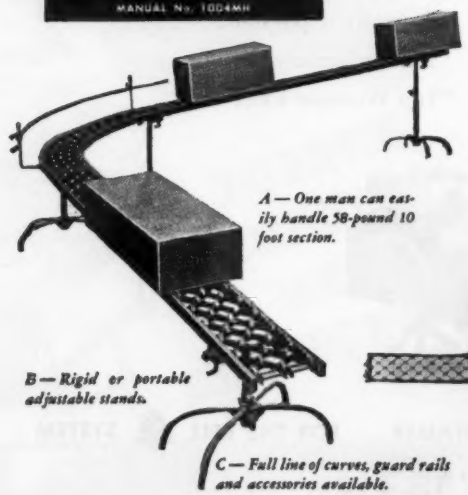

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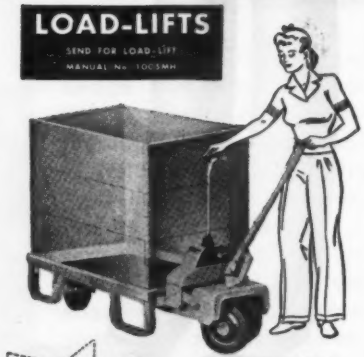

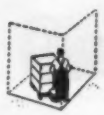

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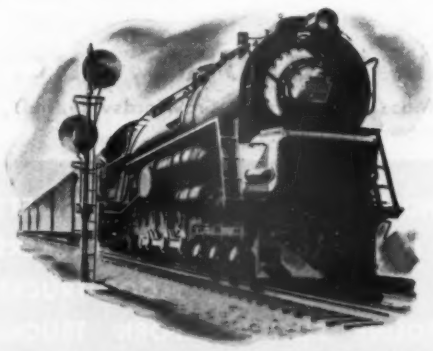
Later, this great inventor-engineer pioneered a single-reduction-gear direct current motor which caused sweeping changes in the operation of street railways.

But a unique achievement in the life of George Westinghouse came in 1905 — when he brought *transportation* and *alternating current* together in a single, masterful triumph of engineering.

For, on May 16, 1905, he successfully demonstrated the first *single-phase main-line* electric locomotive before the delegates to the International Railway Congress, at his plant in East Pittsburgh, Pa.

Shortly afterwards, in 1907, Westinghouse electrified the *first main-line railroad* . . . the New York, New Haven & Hartford, between Woodlawn, New York, and Stamford, Conn.

This spectacular accomplishment heralded the major electrification of railroads the world over.



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THE INSTITUTE GAZETTE

(*Continued from page 372*)

Recognition

PRESIDENT COMPTON recently received the following letter of appreciation for the Institute's war services to the Quartermaster Corps. The letter was signed by Brigadier General Georges F. Doriot, director of the military planning division of the Quartermaster Corps.

"This office wishes to express its appreciation to you and the Massachusetts Institute of Technology for the many important contributions afforded the Quartermaster Corps during the war years.

"We are particularly grateful for the work of the Institute of Food Technology, under the leadership of Dr. Samuel C. Prescott during the early years of the war and later under Professor William Campbell; for the fine technical work of Captain E. Kenyon; and for the very great service rendered to us by Dr. Bernard E. Proctor, who as head of the Subsistence and Packaging Section of the Research and Development Branch distinguished himself by his very able leadership and sound judgment in matters pertaining to the feeding of the Army.

"Mention should also be made of the assistance given to us by four members of the Advisory Board of the Research and Development Branch, who on many occasions generously gave of their time and effort in solving Quartermaster Corps problems; Mr. Bradley Dewey, Dr. Jerome C. Hunsaker, Dr. Robert S. Williams, and Dr. Ernst A. Hauser. I should like also to include Dr. Charles H. Blake for his very capable study of insects and their relation to Quartermaster Corps problems.

"I should like to commend especially Professor Edward R. Schwarz for the research study which was completed for our office on "Wear Resistance of Apparel Textiles." In doing so I should like to include Mr. Kenneth Fox, who until recently was a member of your staff.

"I desire also to take this opportunity to tell you of the very considerable contributions to the work of the Research and Development Branch made by two former students in the Textile Division: Captain Rogers B. Finch and Captain Stanley Backer. Both of these men have established records with us which reflect great credit upon themselves personally and upon your institution.

"I personally want you to know that the contribution of M.I.T. to our work will long be remembered and recognized by the Quartermaster Corps as playing an important part in the total effort to help improve Quartermaster items, and it is hoped that you will continue to be interested in our post-war program of research and development in this field."

Nutrition

AN extended nutritional research program to promote the health and well-being of our fellow Americans of the Caribbean area was announced recently as a joint

(*Continued on page 376*)

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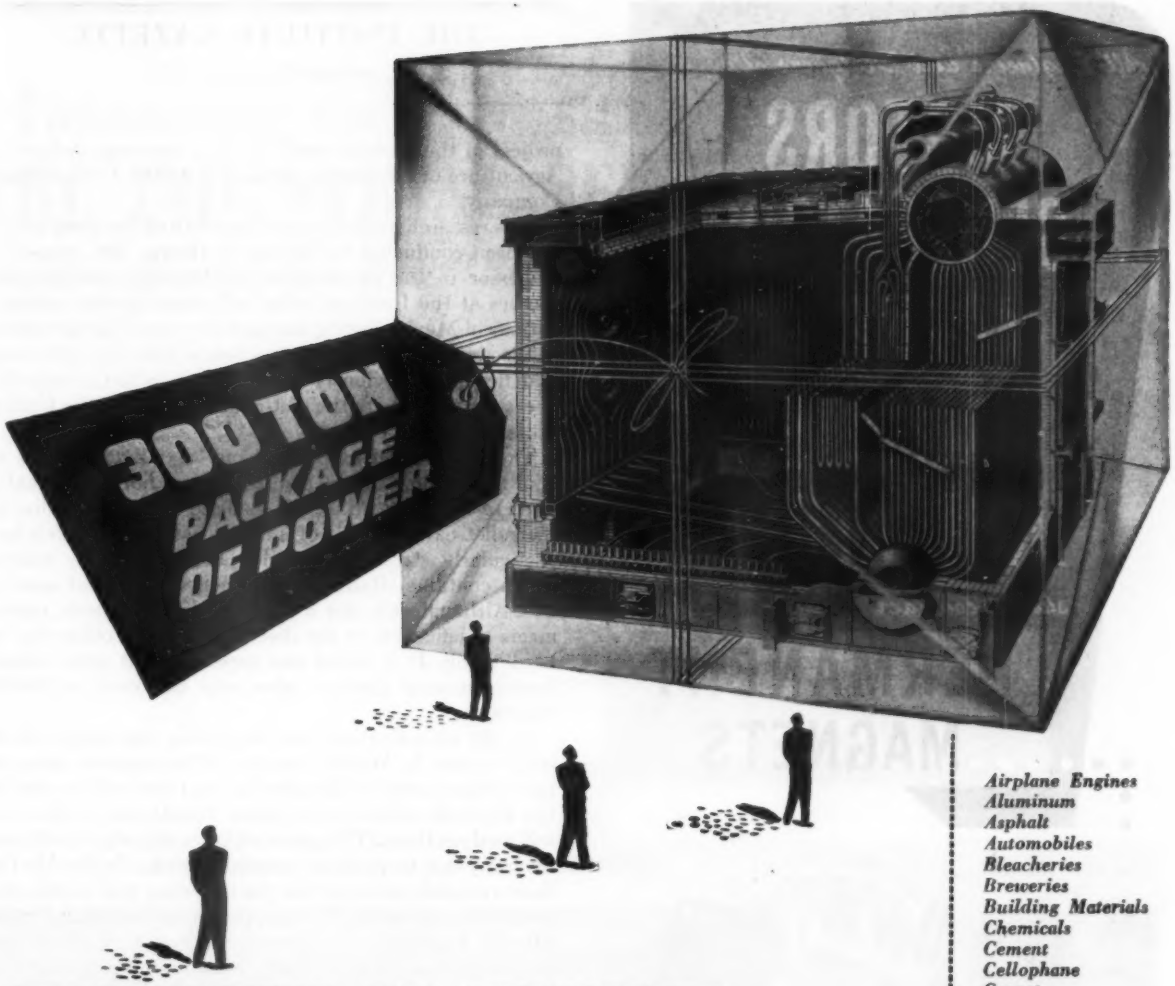

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THE INSTITUTE GAZETTE

(Continued from page 374)

project of the Institute and the Pan American School of Agriculture of Honduras, sponsored by the United Fruit Company.

This research project is an outgrowth of the work which has been conducted by Robert S. Harris, '28, Associate Professor in the Department of Biology, and his colleagues at the Institute, who have made similar investigations in Mexico during the past few years. In the course of the studies in Mexico it was found that the diet is not as deficient as previously supposed but, in fact, is superior in certain respects to the diet in many parts of the United States.

The announcement pointed out that by a process of trial and error over the centuries, the aboriginal inhabitants of the Mexican highlands have learned to utilize in their diet native plants of unusual value. Dr. Harris has particularly stressed one wild plant, known as malva, which contains vitamins in unusual variety and quantities. Although it is not a particularly tasty herb, malva meets a deficiency in the diet which would otherwise be hard to fill. It is hoped and expected that other plants having unusual dietetic value may be found in Middle America.

In the investigation now beginning, specimens of all edible plants in Middle America with complete notes on their characteristics, distribution, and uses will be sent to the Institute laboratories where nutritional biochemists will analyze them. This painstaking work, which will take several years to produce practical results, is the kind of basic research necessary for the nutrition and health program of every nation. This is a pioneering program, for the Middle American area possesses many food plants not known elsewhere and which have not been analyzed before.

The Pan American School of Agriculture, which will collaborate with the Institute in this nutrition program, is directed by Wilson Popenoe, an authority on tropical agriculture. Founded and endowed with permanent maintenance in 1941 by the United Fruit Company as an outgrowth of its lively interest in experimental crops, the school gives free tuition, board, and other benefits to students from all parts of Middle America, who are taught to carry on research in every aspect of theoretical and practical agriculture and forestry.

Appointed

DISTINGUISHED for his work in the inorganic and physical chemistry of the isolation and identification of radioactive atoms, Charles D. Coryell has been appointed professor of chemistry at the Institute, according to a recent announcement by President Compton.

Dr. Coryell was a professor on the staff of the University of California at Los Angeles when he was granted a leave of absence in 1942 to lead a research staff working on the radiochemistry of the fission products in the chemistry division of the Metallurgical Laboratories at the University of Chicago. In 1943 he transferred to the newly opened Clinton Laboratories at Oak Ridge, Tenn., where

(Continued on page 378)

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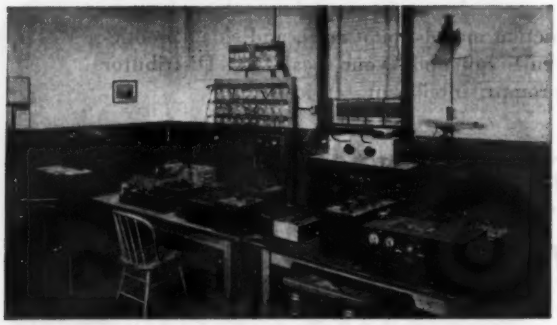

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THE INSTITUTE GAZETTE

(*Continued from page 376*)

he was chief of a research section on radiochemistry and fission products at the first industrial atomic power and plutonium production plant. This work involved intensive research in inorganic, physical, and analytical chemistry, especially that part known as radiochemistry, together with development work on high-activity radiochemical separations and remote control operations. He is now working on the final reports for the project and will join the staff of the Department of Chemistry at the Institute in July.

Born in Los Angeles in 1912, Dr. Coryell is the son of Mr. and Mrs. William H. Coryell. He was educated in the public schools of Los Angeles and Wilmar, where his parents now live, and at the Alhambra High School at Alhambra, Calif. He was a scholarship student at the California Institute of Technology from 1929 to 1932, when he received the degree of bachelor of science in chemistry in three years and was awarded the California Institute of Technology Junior Travel Prize. After a year of graduate study at that institution, he combined the travel prize and the American-German Exchange Fellowship from the Institute of International Education to travel in western Europe. He enrolled for a year at the Technische Hochschule in Munich, where he carried on special investigations relating to the fluorescence of acetone.

Upon his return from Europe, Dr. Coryell carried on graduate work at the California Institute of Technology and was one of the last graduate students of the late Professor A. A. Noyes, '86, at one time acting president of M.I.T. After receiving the degree of doctor of philosophy in physical-inorganic chemistry in 1935, he worked for three years as a research fellow under Professor Linus Pauling, concentrating on the magnetic properties and structural chemistry of hemoglobin and its derivatives with the support of the Rockefeller Foundation. Transferring to the University of California at Los Angeles as an instructor in 1938, Dr. Coryell continued his work on magnetochemistry and structural problems of biologically important substances.

Dr. Coryell's teaching experience has included part-time instructorship at Deep Springs, an experimental private junior college in the California desert, and instructorship in introductory chemistry, quantitative analysis, and physical chemistry at the University of California at Los Angeles. He also gave graduate courses in chemical thermodynamics and the nature of the chemical bond. He was made an assistant professor in 1940 and an associate professor in 1944.

Dr. Coryell is a member of the American Physical Society, the American Chemical Society, the American Association for the Advancement of Science, Tau Beta Pi, and Sigma Xi and is an honorary member of Phi Lambda Upsilon. He has been active in the affairs of the Atomic Scientists and is a charter member of the Association of Oak Ridge Scientists, and a member of the Federation of American Scientists.

In 1937 Dr. Coryell married Miss Grace Mary Seeley of Colorado Springs, Colo. They have one small daughter.

(*Continued on page 380*)

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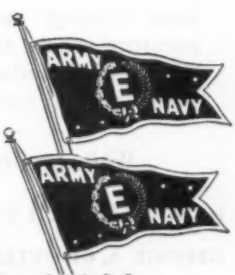

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THE INSTITUTE GAZETTE

(*Continued from page 378*)

Visiting Committee Report

THE Committee on Student Activity* met recently with members of the Institute's Administration, Faculty, and undergraduate body to review plans under preparation and to receive suggestions pertaining to changes in facilities relating to student activities.

The members of the Committee are impressed with the excellence of the plans which have been made and with the wholesome attitude of the Administration toward the problems of student life, and they have submitted for consideration the following points of information and recommendation, certain of which are preliminary, pending the receipt of further information. Most of the proposals have already originated with the Administration and are included here by way of endorsement.

1. Last year the Committee under the chairmanship of E. C. Hadley, '14, recommended that suitable space be provided for students to entertain guests, and Pritchett Hall in Walker Memorial was suggested for this purpose. Because of war conditions, however, it was impractical to proceed with this recommendation.

It is the feeling of the present Committee that this recommendation is sound, and in order to insure that it conforms with present-day plans and conditions the Administration has been requested to submit, through the Walker Memorial committee and the Department of Architecture, recommendations on desirable changes in the Walker Memorial Building to increase its usefulness as a student recreation center.

2. Based upon information received, it is the opinion of the Committee that the interests coming within the scope of the Committee's activity would be well served if the area of the Institute property west of Massachusetts Avenue could be reserved for future expansion of student and Faculty housing and recreational facilities.

3. It would be beneficial to the interests of student activities if one of the plans already drawn by the Administration, or a modification thereof, be adopted as a "goal plan" to be used as a guide to all future expansion of the facilities of the Institute. This plan might designate

* Members of the Committee for 1945–1946 are Donald F. Carpenter, '22, chairman, Raymond Stevens, '17, and J. Willard Hayden.

(*Concluded on page 382*)

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—*Dr. Charles M. A. Stine*

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THE INSTITUTE GAZETTE

(*Concluded from page 380*)

the presently foreseeable use of the entire area of the Institute property, including such property as the Institute may acquire in the future.

4. In the preparation of the goal plan the suggestion of depressing Massachusetts Avenue to provide a convenient overpass connecting the Institute properties on both sides of the avenue has interesting possibilities.

5. The Committee has been informed that the Executive Committee has decided to erect a new dormitory to house from 200 to 300 students. It is recommended that this dormitory be situated west of Massachusetts Avenue in conformity with the second recommendation above.

6. It is recommended that this new senior dormitory provide double rooms and have its own dining service and lounge rooms.

7. It is recommended that provision be made in this dormitory for a house master, who should be single.

8. The Committee recognizes an urgent need for better recreational athletic facilities and has requested the Administration, through the Advisory Council on Athletics and the Department of Architecture, to submit recommendations on desirable changes in and additions to the athletic recreational facilities.

In making these recommendations the following principles are to be given serious consideration: (a) Since a majority of the time in the academic year falls in the cold season, primary attention should be given to indoor sports and outdoor winter sports; (b) sports which have a value to the student after graduation should be favored; and (c) the principle of maximum student participation should take precedence over the desire to provide winning teams.

9. In the development of the area west of Massachusetts Avenue it is recommended that the buildings, their arrangement, and the landscape architecture should be such as to provide the maximum in campus atmosphere.

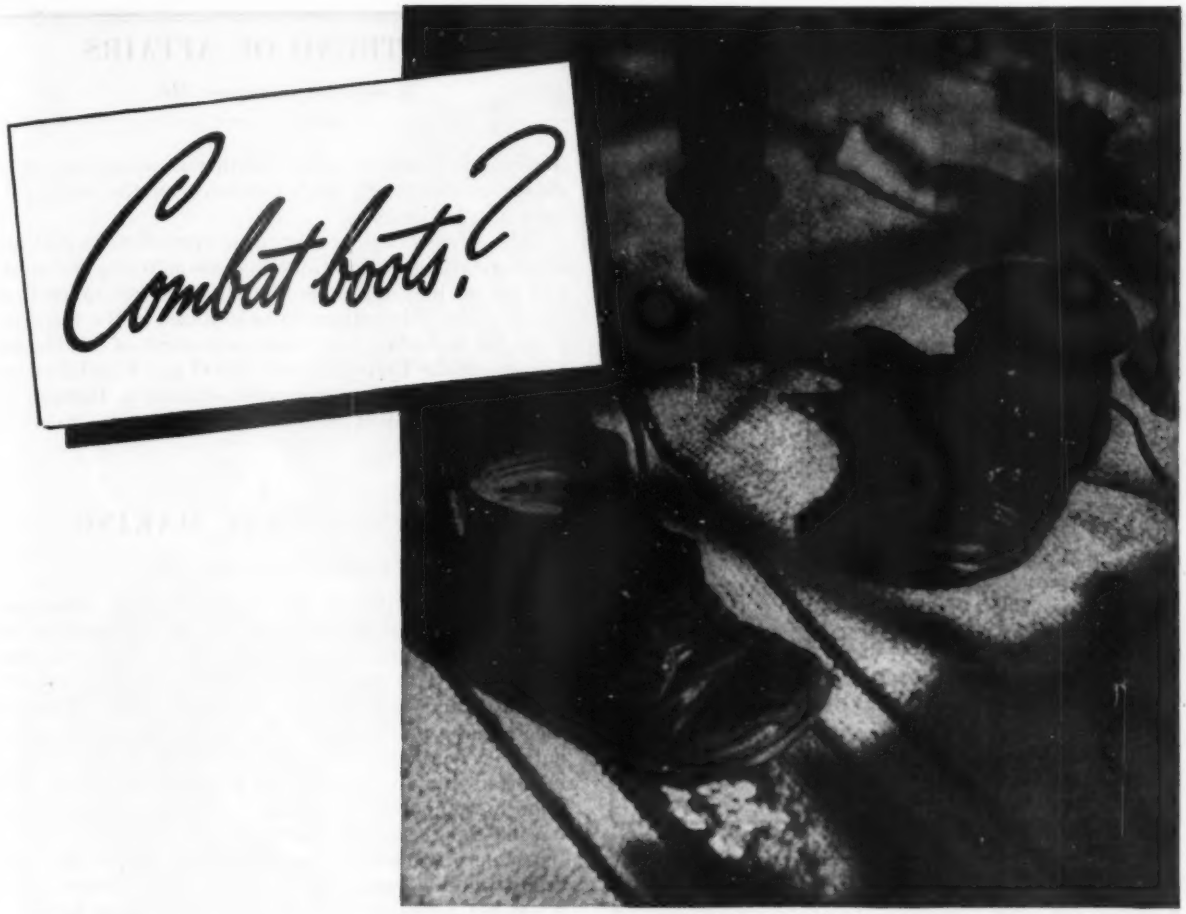
10. All facilities should be in keeping with the high standards of the architecture and construction of the present buildings.

THE STORY OF RADAR

(*Concluded from page 358*)

waves in time to be of value during the war. For a number of years before our entry into the war, the Japanese had tubes capable of producing very short waves (about five inches in length) at low power, but these were not developed or applied in time to be of use in their conduct of the war. By the end of the war many United States airplanes had radar equipment, and the Navy's ships had from one to 20 sets apiece, depending upon the size of the ship and its function.

All these developments and many more came about through the enterprise of research scientists and engineers working in co-operation with the Army, the Navy, and manufacturers in this country. Too high praise cannot be given to the thousands of loyal men and women who worked without thought of personal credit to help win the war. I hope you will be proud of the part M.I.T. played in this great enterprise.



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THE TREND OF AFFAIRS

(*Concluded from page 346*)

continental countries, and diphtheria, which currently shows an abnormally high incidence on the continent, especially in Germany.

Thus, even though active war is over, diseases that are an aftermath of war continue to cause suffering and needless loss of life in Europe. But there is assurance that this tragedy will continue to be localized in the war-torn areas, for according to a recent statement of the Health Division of the United Nations Relief and Rehabilitation Administration, no communicable disease in Europe "is sufficiently prevalent as to constitute a menace to international health."

ENSIGNS IN THE MAKING

(*Continued from page 359*)

some of the routine of the Navy. You are somewhat familiar with its organization, its system of operation, its history and customs, its vocabulary, and its means of communication. This acquaintance will be a definite asset to the Navy and to you in the immediate future. Training together as a unit in uniform and submitting to the same authority has had another collateral effect. You know how important it is to play with the team and not alone. You know how important it is to obey. You have learned what it is like to be subject to the same regulations and to enjoy the same privileges as your shipmates. One of the chief assets was the democratic nature of your existence. Here it was not a case of what a man had, but what he was.

The sense of urgency and responsibility which your officers have tried to inculcate in you has had the effect, we hope, of making it easy for you to put forth your most serious efforts in your studies. The Navy, in this sense, focused the drive generated by the war itself on your more immediate problem — the completion of your education in the shortest possible time. We may also assume that the pressures placed upon you by the Navy were valuable additions to the means the college had for stimulating you to work to the limit of capacity.

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(*Concluded on page 386*)

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ENSIGNS IN THE MAKING

(*Concluded from page 384*)

Atlantic, you will go aboard ships of our fleets. You go not to defeat the enemy or to fight the war. The incentive of the war itself is denied you, and yet your job certainly will not be without importance or meaning, for you are in a position to help bridge a difficult period between war and a secure peace. You will be faced with problems of morale such as always exist in the transition from one period to another.

In addition to your primary duties, you must create incentives and cultivate enthusiasm, for it will be up to you, now in new positions of authority, to keep the men under you both happy and enthusiastic about what they are doing. I know you will do your best. Do your duty to your country, be as good officers as you can, take your places of responsibility in the Navy for as long as you are needed. Serve cheerfully. I know that many of you, once you have tasted Navy life, will want to stay in and make it a career. There are glowing opportunities for service and a useful life. Good men are needed to carry on with the future. I know you will give it every chance before coming to a decision. If you do these things you may safely say to yourselves at the end: "My debt is paid."

PERSONAL RESPONSIBILITY

(*Concluded from page 348*)

individuals we can know now that no community is more generous and broad-minded than the most generous and broad-minded person in it and that there is no courage, no wisdom, no love or hate in an organization, except as it resides in the minds and personalities of the individuals who compose it. And if these qualities cannot by any social alchemy be transferred from us as individuals to the organizations of which we are a part, if these qualities exist only in us, then it seems to me clearly to establish our individual responsibility for their cultivation and their preservation. It is an antidote to the discouragement of seeing ourselves as little cogs in a great machine. We must keep before us the fact that it is the individual, some individual, who determines the character of every organization.

It is our responsibility in an age of power to retain our capacity to see in every personality a unique being, capable of unfolding all the potentialities of the race itself. No matter how much we must organize ourselves, we must guard against the danger of thinking of human beings as impersonal units — of speaking of management and labor rather than of managers and of people whose work is not managerial, of man power rather than of men and women, of youth rather than of boys and girls. We must try to capture the insight of Sir William Watson's poem:

> Momentous to himself, as I to me,
> Hath each man been that ever woman bore;
> Once, in a lightning-flash of sympathy,
> I felt this truth, an instant, and no more.

It is our responsibility in an age which is equipped with tremendous powers of destruction, never to allow them to be used to destroy the worth, the dignity, and the importance of individuals. We must prolong the lightning-flash of sympathy for a lifetime, not merely for an instant.

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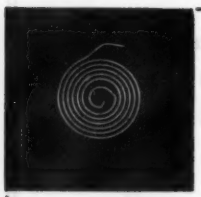

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TODAY'S PROBLEM

(*Continued from page 354*)

conditions in order to co-operate with the harassed ground forces, their losses due to weather (crashes on take-off and landing and collisions in the air) were greater than the losses due to enemy action.

Air mass analysis, global weather forecasting, long-range forecasting, and synoptic climatology all have improved our ability to forecast weather, but much more work has to be done before meteorology has made its proper contribution to air safety. More information and more accurate information is required.

Ice formation on the wings and other parts of the airplane has long constituted a serious hazard. Further development of pneumatic, thermal, and chemical de-icers is required.

Fog remains our greatest enemy. Radio and radar locating devices and instrument landing equipment are now available but must be simplified, standardized, and installed.

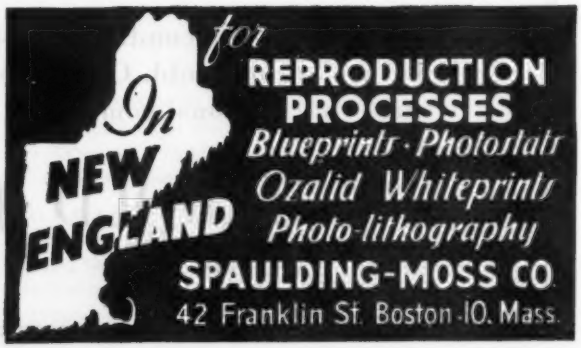
On V-E Day, three bombardment groups in the Eighth Air Force had been equipped and trained to operate regardless of weather conditions. They were able to take off, fly to and bomb the targets, return, and land without ever having seen the ground. In time, the entire air force would have had this training. The Army Air Forces has an "all weather unit" in training now, which is developing equipment for flying in all kinds of weather. When perfected, the equipment and techniques it develops will be made available to the air lines. There are many safety appliances developed now which should be installed and made available to assist the private flier and the airline operator.

During the war the microwave early warning set enabled us to rendezvous our fighters with our bombers, to detect and intercept enemy fighters, to assist in the navigation of our planes, and to tell them, at all times, exactly where they were — within the range of the equipment, which was about 250 miles.

The loran system of navigation, developed in the Radiation Laboratory at M.I.T., was, by V-J Day, installed throughout the Pacific area and in most parts of the world, so that at all times an airplane navigator knew where he was, within a mile.

Oddly enough, all of the known safety devices are not yet in general use. The problem is not only the development and perfection of equipment but its purchase, installation, and employment. While continuing development, we should install the best equipment now available.

(*Concluded on page 390*)



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TODAY'S PROBLEM

(*Concluded from page 388*)

Every major airfield should install an instrument landing system, and every transport airplane should have the necessary airborne equipment and a pilot trained to use it. Every major airport should have a radar set in order to keep a constant check on all planes in the landing pattern. Planes flying the transcontinental routes should be followed by radar at all times and, in bad weather, should be advised if they are off course or in danger. The entire transcontinental system should be tied together with a microwave communications network so that the location of every plane is known at each moment, and this information can be passed on to any airplane desirous of receiving it. Storms and mountains could then be readily avoided, and landings at destination expedited.

But it is not only the world of technology which is steadily evolving. The same trend exists in the fields of human relationships, as described, for example, by political and social science. During my lifetime, income taxes appeared in our country. The first major effort to secure international peace was made. The League of Nations failed, but a new effort, which we hope will take advantage of the lessons of the past and will succeed, is now being formed. In my generation the labor unions became powerful organizations, and security became a watchword for the masses of the people.

With the idealism, energy, and inexperience of youth, it is traditional for each generation to say that the preceding generation failed and to predict confidently that the new generation is far too smart and high-minded to make such mistakes. To a certain extent such claims are true and form part of the driving force which will lead us, we still believe, to an ever better world. There lurk here, however, also a danger and a warning.

Not long after the victorious end of World War I it became evident that the millennium was far from having been achieved, and there was common talk among the young people of that period that the older generation had made a mess of things. Unfortunately, this was largely true. Now, however, after World War II the affairs are in the hands of people approximately one generation older than those of World War I, the critics of the former generation. I think, as we look over our internal and also our international affairs, we can see a distinct danger of even greater failures. There is, however, the possibility of a very great step forward in the art of international living and improvement in our domestic standards of life. In effect, today's problems, wisely handled, should lead to a peaceful, better world. In addition to wisdom, there is a very urgent need for courage and perseverance, for a firm resolve to see things through to a finish, for a sense of responsibility and public duty in the mind and heart of every citizen, which, rather than temporary indulgence or self-interest, will determine his course of action in this critical period.

In discussing these problems, I have spoken of your generation and of my generation. Fortunately, these two overlap.

Actually, the problems to which I have referred do not belong to only one generation. They are passed on from each generation to the next in a continuous and closely interlinking fashion. It is inevitable, nevertheless, that the young men of your age will before long be carrying the primary responsibilities for this country and for the world, and it is important that we all join forces to handle these problems with vision, skill, and courage.

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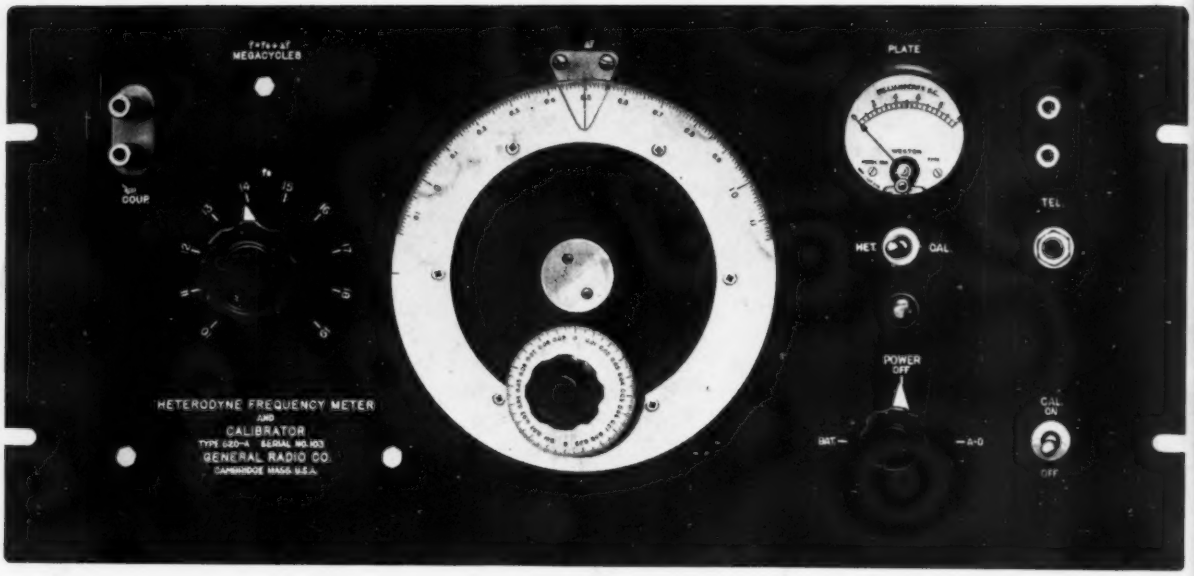

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